DOCUMENT RESUME

ED 112 255 CE 005 281

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TITLE	Tree-Fruit Production. An Instructional Unit for Teachers of Adult Vocational Education in Agriculture.
INSTITUTION	Kentucky Univ., Lexington. Div. of Vocational Education.
SPONS AGENCY	Kentucky State Dept. of Education, Frankfort. Bureau of Vocational Education.
REPORT NO	VT-102-059
PUB DATE	75
NOTE	125p.; For related documents, see CE 005 271-282
EDRS PRICE	MF-$0.76 HC-$5.70 Plus Postage
DESCRIPTORS	*Adult Farmer Education; Adult Vocational Education; Agricultural Education; *Agricultural Production; Curriculum Guides; Instructional Materials; *Teaching Guides; *Trees; Vocational Agriculture; *Young Farmer Education
IDENTIFIERS	*Fruit Trees

ABSTRACT

Designed as a guide for teachers in planning and conducting young and adult farmer classes, the unit covers the basic areas of tree-fruit production. The format of the 10-lesson unit allows for the utilization of the problem-solving and discussion methods of teaching. The major objective of the unit is to develop the ability to effectively establish and manage a tree-fruit production enterprise. Topics of study include: orchard site selection, establishing and propagating fruit trees, pruning, soil management, thinning trees, insect and disease control, harvesting and marketing, and managing home fruit production. The appendix includes teaching forms and a unit evaluation questionnaire. (NJ)

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TREE-FRUIT PRODUCTION

An Instructional Unit for Teachers
of Adult Vocational Education in Agriculture

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CE 005 281

(VT 102 059)

1975

FOREWORD

Mr. Robert O'Bryan, teacher of vocational agriculture at Johnson Central High School, brings to this publication seven years of teaching experience, five years of which included teaching adult farmers in Johnson County. He holds the B.S. and M.S. degrees from the University of Kentucky. The Johnson County VoAg Department has five acres of land on which potatoes, corn, Christmas trees, and a fruit orchard are grown. A 28 x 48 foot greenhouse was put in operation in the fall of 1974. Johnson County is a leading apple-producing county with over 70,000 bushels produced in 1972.

This adult-farmer course is a result of the following sequence of actions:

1) The State Advisory Committee, made of agriculture teachers, state staff, and teacher educators from throughout Kentucky, was organized to determine needs and program direction for adult work in agriculture for the state. A major outcome of the first meeting in September, 1971, was a recommendation that more instructional materials that are specifically designed for teaching adults in agriculture be developed and distributed to teachers.

2) Subsequently, a proposal to involve experienced teachers of adults in development of material was written by Dr. Maynard Iverson of the University of Kentucky and submitted for state funding. In January, 1972, a special project grant was made through the Supporting Services Division, Bureau of Vocational Education, State Department of Education.

3) Twelve teachers were selected to produce units in the diverse areas of need during the course of the project.

This publication, along with other materials developed specifically for instruction of adults employed in agriculture in Kentucky, should

improve the teaching of adult classes in agriculture and stimulate the initiation of additional classes.

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ACKNOWLEDGEMENT

We are grateful to the following for their valuable assistance with the unit: Clarence Meek, Vocational Agriculture Teacher, Johnson Central High School, for his many suggestions in developing the course content; Raymond Gilmore, Steve Statzer and Tom Vantreese, artists, and Dr. Herbert Bruce, Director, Curriculum Development Center, University of Kentucky; Dr. Carl Chaplin, Professor of Horticulture, University of Kentucky, for suggestions on visuals; Dr. Frank Pattie, Professor Emeritus, University of Kentucky for critical review of the manuscript; Mrs. Anne Mills, secretary, and Miss Susan Roberts, typist, Department of Vocational Education, University of Kentucky; Dr. Robert Schneider, Director, Educational Resources Development Unit, Bureau of Vocational Education, for his support in financing the project; the many authors and agencies whose publications were utilized in the unit; and especially W. D. Armstrong, whose painstaking efforts in reviewing the manuscript improved the usefulness of the publication.

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SUGGESTIONS FOR USING THE COURSE

This unit was developed as a guide for use by teachers in planning and conducting young-farmer and/or adult-farmer classes. Because of the diversity in age, expertise and, experience levels of class members and instructors, the unit was designed to cover the basic areas of Tree-Fruit Production. Therefore, teachers should adapt those portions of the unit that are suited to their particular situation. Ten lessons have been included, but the unit may be expanded to more topics or utilized in diversified courses for shorter periods of instruction. It may be helpful to involve class members at the organization meeting in the selection of lessons and activities. Planning forms to assist in this process are found in the appendix. We highly recommend that the major teacher reference, Modern Fruit Science, by Childers, be secured by anyone planning to utilize this unit.

The format used was designed to assist teachers in utilizing problem-solving and the discussion method. A teaching procedure that has been used successfully is as follows: Step 1: The teacher lists the topic (problem and analysis) on the chalkboard. Step 2: He then sets the stage for discussion with introductory facts, ideas, or comments, using items from the section on "developing the situation." Step 3: The teacher calls on the class to give their experiences, ideas, and knowledge concerning the subject. The discussion is supplemented with handouts, transparencies, models, or other inputs gathered by the teacher beforehand to help solve the problem under consideration. Resource people or films may also be used here as sources of information. (Transparency and handout masters are found at the end of each lesson in the unit.) Step 4: When the facts have been brought out and a good discussion has taken place, the teacher leads the group to appropriate conclusions. These summary statements are written on the chalkboard and, in some cases, are typed up and distributed as handouts at the next meeting. Some instructors will utilize devices such as panels, exhibits, and tours to reinforce the conclusions reached. Several suggestions for supplementary enrichment activities are listed in each lesson of this unit.

Teachers may want to utilize the wealth of resources found in each community to supplement their teaching -- local fruit growers, extension fruit specialists, chemical company representatives, and others will undoubtedly be pleased to serve as resource people, furnish samples, give demonstrations, conduct tours, arrange for films and assist with other activities appropriate to the success of the course.

Each teacher using the unit is asked to complete and return the evaluation questionnaire found in the appendix. These ratings and suggestions will be used to improve this unit as well as others developed in the future.

Our best wishes for a successful adult program.

Robert C. O'Bryan
Development Consultant

Maynard J. Iverson
Project Director

UNIT OBJECTIVES

Major objective: To develop the effective ability of individuals to establish and manage a tree-fruit production enterprise.

Lesson objectives: To develop the effective ability of growers to:

1. Establish a tree-fruit production enterprise.
2. Select the orchard site.
3. Establish a fruit-tree orchard.
4. Propagate fruit trees.
5. Prune fruit trees.
6. Manage orchard soil.
7. Thin fruit trees.
8. Control insects and diseases in fruit trees.
9. Harvest and market fruit.
10. Manage home fruit production.

UNIT REFERENCES

Books:

Baker, Jerry, Make Friends With Your Fruit Trees, Simon and Schuster, New York, 1973.

Childers, Norman Franklin, Modern Fruit Science, Somerset Press, Inc., New Jersey, 1973.

Scheer, Arnold H. and Juergenson, Elwood M., Approved Practices in Fruit Production, The Interstate Printers and Publishers, Inc., Illinois, 1964.

Schneider, G. W. and Scarborough, C. C., Fruit Growing, Prentice-Hall, Inc., New Jersey, 1960.

Williamson, Joseph F., Editor, and others, Sunset Pruning Handbook, Menlo Park, California; Lane Books, 1972 ($1.95)

Kentucky Extension Bulletins:

Apple Spray Schedule, ID-10.

Chemical Control of Weeds in Vegetable and Fruit Crops in Kentucky, ID-22.

Growing Fruit at Home, HO-23.

Peach Variety Performance, HO-6.

Recommendations for Establishing a Home Fruit Orchard of Dwarf or Semi-Dwarf Apple Trees, by W. D. Armstrong and Claude Christian.

Recommended Varieties for the Home Fruit Garden, HO-22, 1974.

Roadside Marketing in Kentucky, ID-4.

Sprays for Home Fruit Planting, ID-21.

Stone Fruit Spray Schedule, ID-11.

Training the Spur-Type Apple Tree, Misc. 317.

Other Publications:

Agricultural Pesticides, Adult Vocational Agriculture Instructional Unit 109, Department of Vocational Agriculture, University of Kentucky, 1973.

Dwarf Fruit Trees, Selection and Care, Leaflet No. 407, USDA.

Establishing and Managing Young Apple Orchards, Farmers' Bulletin No. 1897, USDA.

Fruit: Suggested Spray Guide, Niagara Chemical Company.

Grafting and Budding Fruit Trees, Extension Bulletin 379, Rutgers University, New Jersey.

Kentucky Agricultural Statistics, U. S. Department of Agriculture Statistical and Reporting Service and Kentucky Department of Agriculture Division of Markets (latest edition).

Tree-Fruit Production Recommendations, Extension Bulletin 407, Cooperative Extension Service, Rutgers University, New Jersey, 1973.

Lesson 1

ESTABLISHING THE TREE-FRUIT PRODUCTION ENTERPRISE

Objective -- To develop the effective ability of landowners to establish a tree-fruit production enterprise.

Problem and Analysis -- How should we establish a tree-fruit production enterprise?

-Trends in fruit sales
-Marketing facilities
-Where fruit is produced
-Labor and management requirements

Content

I. Trends in Fruit Sales.

A. Overall fruit sales are on the increase; however, climatic conditions and other factors affect production, thus total fruit sales fluctuate.

B. Types of fruit production
1. Small fruits are: strawberries, grapes, raspberries, blackberries, dewberries, blueberries, and gooseberries.
2. Tree fruits are: apples, peaches, pears, cherries, and plums.

C. Statistics are unavailable for most of the above fruit crops in Kentucky; however, facts are available for apples, peaches, and, for comparison, strawberries and other fruits and nuts.

Sales of Fruit in Dollars (Ky.)*

Fruit	1970	1971
Apples	$1,183,000	$1,449,000
Peaches	889,000	1,030,000
Strawberries	723,000	798,000
Other Fruits and Nuts	154,000	178,000

1. Kentucky's 1971 apple production totaled 20 million pounds, up nearly one-fifth from 1970 crop of 17 million pounds.

*Source: Kentucky's Agricultural Statistics, 1972, p. 57.

2. Peach production in 1971 totaled 15.5 million pounds, 24 per cent above the 1970 crop.

3. Strawberry acreage decreased to only 600 acres in 1971, but yield was at a record high 4,600 pounds per acre. Acreage has decreased steadily since peaking at 6,200 acres in 1956. Preliminary figures for 1972 showed 700 acres.

II. Marketing Facilities.

A. The market outlook for fruit in Kentucky looks good at the present time.

B. Potential market outlets are:
1. Roadside markets
2. Pick-your-own
3. Retail selling
4. Selling to processors
5. Co-op selling
6. Packing for shipment to the open commercial market.

III. Where Fruit is Produced.

A. California produces over one-fourth of the fruit in the U.S.

B. The following chart indicates top-producing states, listed in order of production.

Leading States in Tree-Fruit Production, (1972)

Apples	Peaches	Pears	Cherries *
Washington	California	California	Michigan
New York	South Carolina	Oregon	Oregon
Michigan	Georgia	Washington	California
California	New Jersey	Michigan	Washington
Pennsylvania	Pennsylvania	New York	New York
Virginia	Michigan		Utah
West Virginia	Washington		Pennsylvania
North Carolina	Arkansas		Wisconsin
Ohio	Virginia		
New Jersey	Alabama		

IV. Capital Requirements.

A. Capital requirements vary with type of fruit production.

B. The land owner will need to analyze the following items:
1. Kind of fruit production engaged in.
2. Amount of land suited for selected type of production.
3. Number of plants or trees required.
4. Amount and kind of equipment required for the type of production.

*Source: Modern Fruit Science, Childers.

C. Generally, more capital is required for tree-fruit production.

V. Labor and Management Requirements.

A. In producing and marketing perishable products, good management is of utmost importance.

B. The manager must know and understand the crop he is producing.

C. In producing tree fruits, large amounts of labor are required at harvest time, and during fruit thinning.

D. Generally, more labor is required for tree-fruit production than for small fruit.

E. In determining labor requirements, consider the following:
1. Type of fruit production.
2. Peak labor periods--(if orchard heating is done), harvesting, thinning, pruning, and spraying.
3. Local labor market.
4. Other farm labor requirements.

Suggestions for Teaching the Lesson

I. Developing the Situation.

A. Teacher contribution:
1. Most fruit production should be considered for a fairly long period of time. To come into full production, small fruits require 2-4 years; tree fruits need 6-10 years.
2. According to Kentucky Agricultural Statistics, fruit production and sales are increasing.
3. Horticulture specialists indicate that Kentucky has great potential for increased fruit production.
4. Tree-fruit production requires a considerable amount of capital and labor.
5. The producer must be a good manager and follow a rigid time schedule in order to be successful.

B. Things to be brought out by the class members:
1. Their ideas and knowledge of tree-fruit production.
2. Their opportunities to engage in tree-fruit production.
3. Kind of tree-fruit production class members are interested in.

II. Conclusions.

A. Kentucky has the potential for substantial increases in fruit production.

B. The landowner will have to select the type of production that best fits his operation.

C. Good management practices are required for all phases of fruit production.

D. Persons entering fruit production should seek advice from qualified specialists.

E. Surveys will help determine market potential.

F. Potential market outlets are available.

G. Many sections of Kentucky show great potential for tree-fruit production.

III. Enrichment Activities.

A. Visit a fruit grower.

B. Invite fruit experts to speak to the class.

C. Visit a local marketing co-op.

D. Visit the nearest University orchard.

IV. Suggested Teaching Materials.

A. References for lesson 1
1. Modern Fruit Science, pp. 3-30.
2. Kentucky Agricultural Statistics, 1971, pp. 50-53 and pp. 55-58.

B. Resource personnel
1. Consult local people (producers, marketing people, etc.)
2. Extension fruit specialists
3. For specific personnel see Vo-Ag Directory of Resource People in Kentucky

C. Audio-visuals
1. Masters*
-1 Fruit Sales in Kentucky
-2 Leading States in Tree-Fruit Production
-3 Apple, Peach, and Strawberry Production in Kentucky
-4 Kentucky Fruit Production and Value
-5 Potential Market Outlets

*Note: Masters are keyed to units and lessons, and are numbered consecutively. The code number appears in the lower right hand corner. Master 111-1-1A would indicate: adult unit 111, lesson 1, item 1, part A.

SALES OF FRUIT IN DOLLARS (KY.)

Fruit	1970	1971
Apples	$1,183,000	$1,449,000
Peaches	889,000	1,030,000
Strawberries	723,000	798,000
Other Fruits and Nuts	154,000	178,000

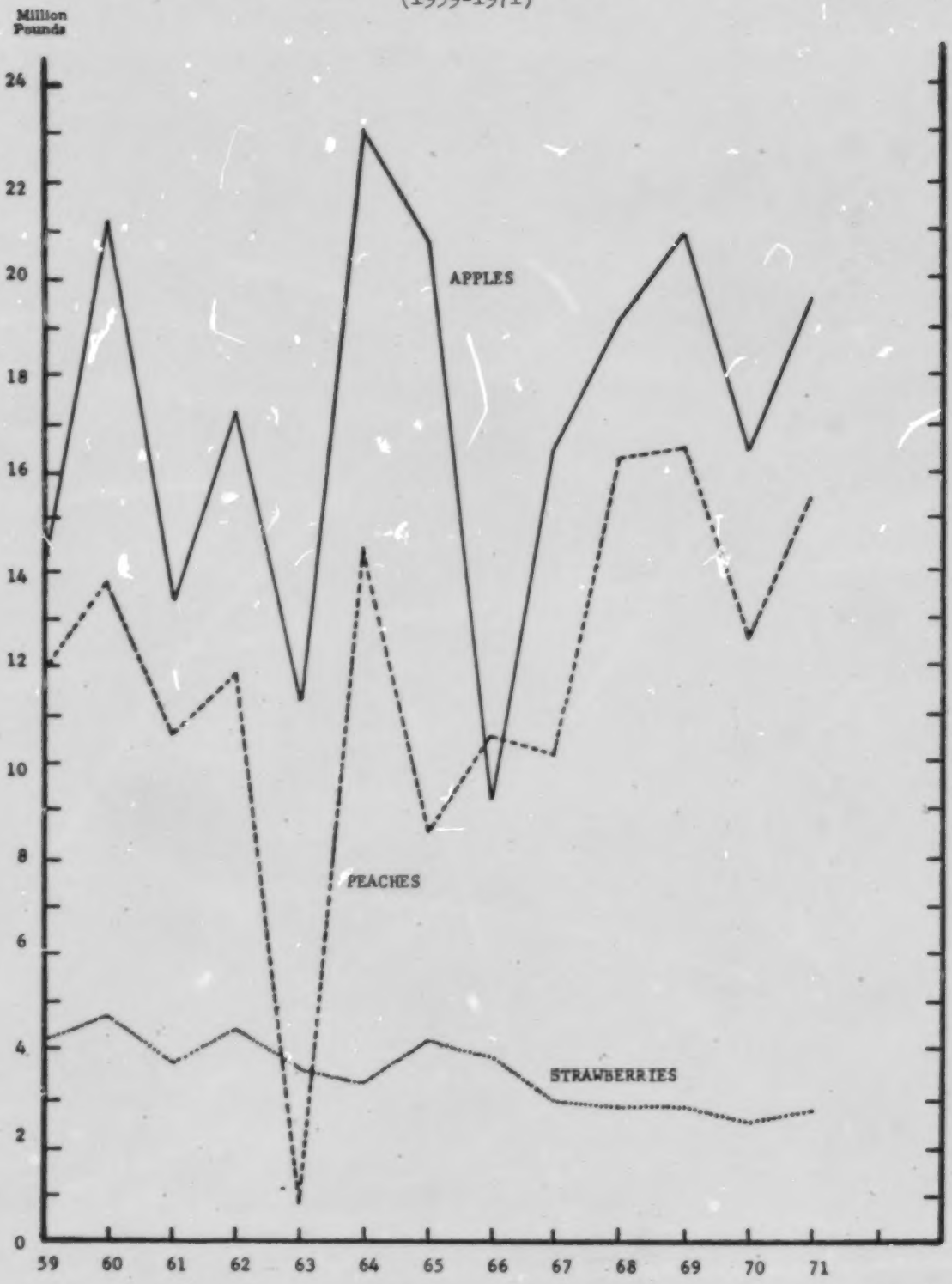
Source: Kentucky Agricultural Statistics, 1971. 111-1-1

LEADING STATES IN TREE-FRUIT PRODUCTION, 1972

Apples	Peaches	Pears	Cherries *
Washington	California	California	Michigan
New York	South Carolina	Oregon	Oregon
Michigan	Georgia	Washington	California
California	New Jersey	Michigan	Washington
Pennsylvania	Pennsylvania	New York	New York
Virginia	Michigan		Utah
West Virginia	Washington		Pennsylvania
North Carolina	Arkansas		Wisconsin
Ohio	Virginia		
New Jersey	Alabama		

*Sweet and sour cherries are included here.

Apple, Peach, and Strawberry Production in Kentucky
(1959-1971)



Source: Kentucky Agricultural Statistics, 1971. III-1-3

KENTUCKY FRUIT PRODUCTION AND VALUE 1964-1972

	Production		Price	Value of
	Total	Utilized	Per Unit	Utilized Production
	Commercial Apples			
	Million Pounds		Cents Per Pound	(000 $)
1964	23.0	21.6	5.33	1,151
1965	20.7	19.6	5.66	1,109
1966	9.2	8.5	5.94	505
1967	16.4	16.4	5.95	976
1968	19.8	18.8	6.37	1,198
1969	21.5	20.6	6.00	1,236
1970	17.0	16.2	6.80	1,102
1971	20.0	19.4	5.95	1,154
1972[1]	15.0	14.4	6.93	998
	Peaches			
1964	14.4	14.4	6.02	867
1965	8.6	8.6	6.29	541
1966	10.6	10.6	6.61	701
1967	10.2	10.2	8.05	821
1968	16.3	16.3	7.50	1,223
1969	16.5	16.5	7.10	1,172
1970	12.5	12.5	7.60	950
1971	15.5	15.5	7.10	1,101
1972[1]	5.0	5.0	11.50	575

[1]Preliminary.

FRUITS AND VEGETABLES CASH RECEIPTS FOR KENTUCKY AND UNITED STATES 1969-1971[1]

	KENTUCKY (1000 DOLLARS)			UNITED STATES (1000 DOLLARS)		
	1969	1970	1971	1969	1970	1971
Fruits & Nuts						
Apples	1,332	1,183	1,449	312,501	277,672	310,431
Peaches	1,108	889	1,030	182,781	174,409	173,649
Strawberries	748	723	798	112,120	108,683	118,514
Other Fruits & Nuts	155	154	178	43,960	45,995	48,479
All Fruits & Nuts	3,343	2,949	3,455	2,191,715	2,089,297	2,358,116
Vegetables						
Potatoes	178	163	142	620,629	663,988	581,559
Tomatoes[2]	919	935	1,250	420,463	402,082	471,484
Misc. Vegetables	2,747	5,070	4,631	834,561	886,041	835,245
All Vegetables	3,844	6,168	6,023	2,802,517	2,824,982	3,024,292

[1]Cash receipts are on calendar year basis.
[2]Fresh only, processing included in miscellaneous vegetables.

Source: Kentucky Agricultural Statistics, 1971. 111-1-4

POTENTIAL MARKET OUTLETS

1. Roadside markets
2. Pick-your-own
3. Retail selling
4. Selling to processors
5. Co-op selling
6. The national commercial market

Lesson 2

SELECTING THE ORCHARD SITE

Objective -- To develop the effective ability of orchardists to properly select the orchard site.

Problem and Analysis -- What factors should be considered in selecting the orchard site?

-Elevation
-Soil selection
-Terrain
-Water supply

Content

I. Elevation

A. Favorable elevation is important when selecting the orchard site.

B. Cold air flows like water, down hill, thus valleys in most cases are undesirable for fruit production.

C. Orchards located on ridges may be severely damaged by wind.

D. Areas in and around a large body of water may be suitable for the orchard site because of the tempering effect from the water.

E. The area between the orchard and the valley should be relatively free of other trees to allow good air drainage from the orchard into the valley.

F. Under certain conditions, a difference of 5 to 10 degrees in temperature may be realized for each 100 feet of elevation.

G. Generally, the direction of slope has little, if any, effect on the fruit crop. However, a north slope reduces damage from late frost, since fruit set (budding) is delayed.

II. Soil Selection

A. Since physical properties of the soil cannot be changed, soil selection is very important.

B. Orchard soil should be fertile, deep, and well drained.

C. Soils should be in a pH range of 6.0-6.5.

D. Recommended soil textures range from sandy loam to clay loam.

E. The soil (topsoil and subsoil) should be at least five feet deep; however, deeper soils are more desirable to allow for root development.

III. Terrain

A. The terrain is an important factor to consider in locating the orchard.

B. Rough and steep terrain will create severe management problem. Among these are problems in cultivation, spraying, harvesting, pruning, and transportation to and from the orchard. A long slope will allow cold air to drain from the orchard.

C. All cultural operations should be carefully considered when selecting the orchard site.

IV. Water Supply

A. A good water supply is a must in fruit production.

B. During dry weather, water may be needed for irrigation in some areas.

C. The orchard spraying program requires large amounts of water. The water should be conveniently located.

D. Water may be supplied from a well or lake in or near the orchard.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
1. Trees are perennial plants, so proper site selection is a critical factor for insuring good production.
2. Major factors in site selection.

B. Things to be brought out by the class members.
1. Their ideas for an orchard site, including elevation, soil, terrain, and water supply.
2. Each member's situation so far as securing a good orchard site on his farm.

II. Conclusions

A. Proper elevation will insure good air drainage from the orchard into the valley; 100 feet in elevation could make a difference of 5 to 10 degrees in temperature.

B. Large bodies of water have a tempering effect and should not be over looked.

C. Orchard soils may range from sandy loam to clay loam; however, they should be fertile, deep, and well-drained.

D. A soil pH of around 6.0-6.5 is recommended.

E. The terrain should allow for air drainage and equipment use.

F. A large amount of water is necessary for fruit production.

III. Enrichment Activities

A. Visit orchards in the community and evaluate their location.

B. Invite established producers to talk to the class about site selection.

C. Visit class members' farms and evaluate possible orchard sites.

IV. Suggested Teaching Materials

A. References for lesson II
1. Modern Fruit Science, pp. 31-40.
2. Approved Practices in Fruit Production, pp. 53-56.
3. Fruit Growing, pp. 2-9.

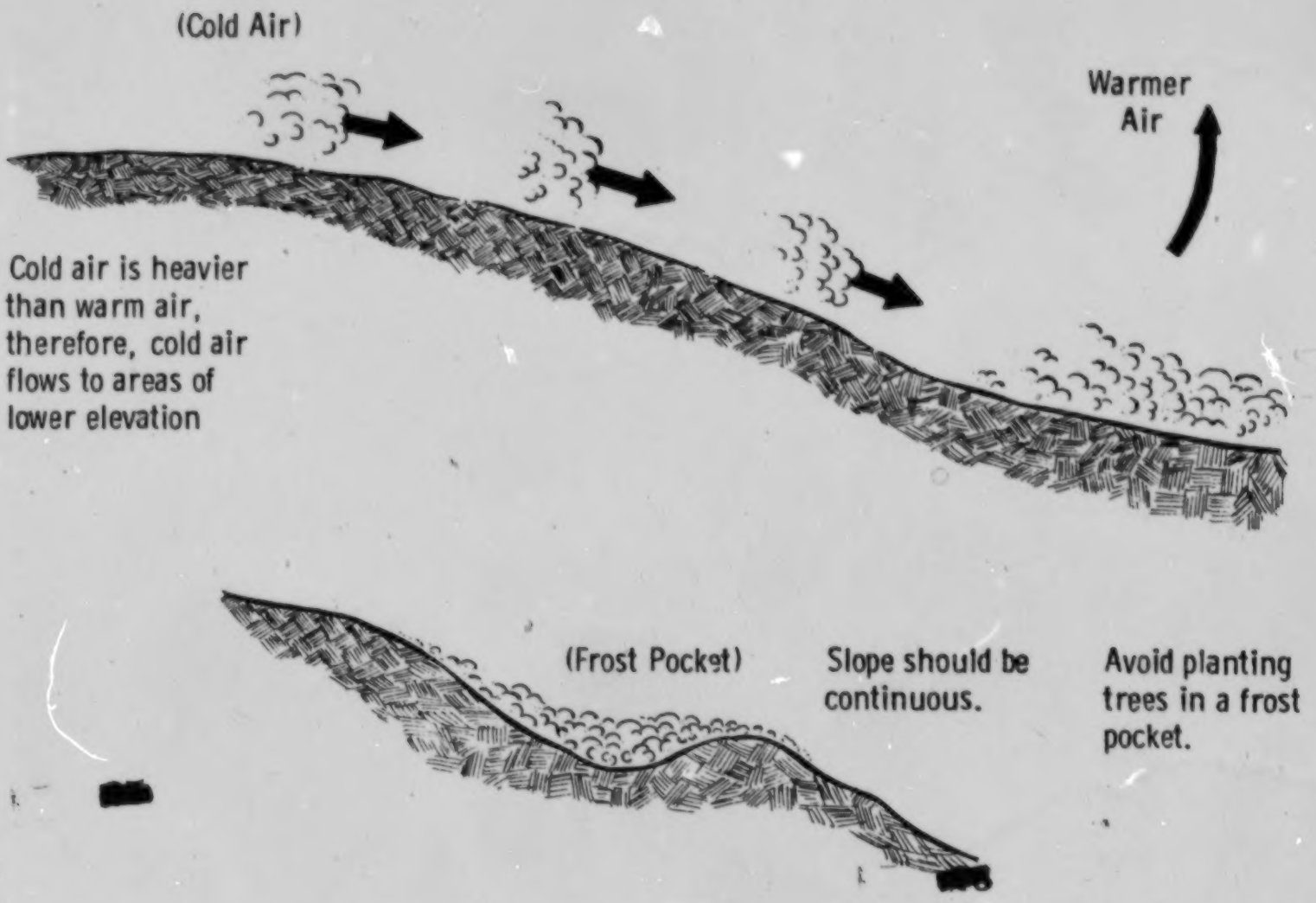
B. Resource Personnel
1. Local producers
2. Extension fruit specialists
3. For specific personnel, see Vo-Ag Directory of Resource People in Kentucky.

C. Audio-visuals
1. Masters
-1 Major Factors in Site Selection
-2 Air Drainage

MAJOR FACTORS IN SITE SELECTION

- Elevation
- Soil Selection
- Terrain
- Water Supply

AIR DRAINAGE


(Cold Air)
Warmer Air
Cold air is heavier than warm air, therefore, cold air flows to areas of lower elevation
(Frost Pocket)
Slope should be continuous.
Avoid planting trees in a frost pocket.

111-2-2

Lesson 3

ESTABLISHING THE ORCHARD

Objective -- To develop the effective ability of growers to establish an orchard.

Problem and Analysis -- How shall we establish the orchard?

-Selection of trees
-Obtaining the trees
-Care of trees after arrival
-Land preparation
-Tree planting

Content

I. Selection of Trees

A. Selection of the right tree for the job is one of the most important phases of fruit growing.

B. When selecting varieties consider the following factors:
1. Pollination effect. Some varieties must be cross-fertilized before they will set fruit.
2. Adaptation. Select varieties that are adapted to the climatic condition.
3. Expected return. Select high-return varieties.
4. Dependability. Choose varieties that are dependable.
5. Labor requirements. Choose varieties that will spread the labor load.
6. Hardiness. Select varieties that are not susceptible to disease, insect, and cold injury.
7. Life expectancy. Select varieties that have a long producing life.

C. The following chart shows the sizes and other characteristics of trees that are produced on different rootstocks.

Characteristics of Different-Sized Fruit Trees

Size of Tree	Rootstock*	Anchorage of tree in soil	Adaptability of tree to soil
Full size (standard)	Seedling	Very good	All types
Full size and semistandard (3/4 standard)	MM 104	Very good	All types, but avoid wet sites

(continued on next page)

Characteristics of Different-Sized Fruit Trees (continued)

Size of Tree	Rootstock*	Anchorage of tree in soil	Adaptability of tree to soil
Semistandard	MM 111	Very good	All types; tolerates dry or sandy soil
Semistandard	M 11	Good	Most soils are satisfactory; avoid very sandy, heavy, or wet soil
Semistandard and semidwarf ($\frac{1}{2}$ standard)	MM 106	Very good	All types
Semidwarf	M VII	Good-fair	All types except light soils
Semidwarf and dwarf ($\frac{1}{4}$ standard)	M 26	Fair-Good (but needs support)	Use on good soils; avoid light soil
Dwarf	M IX	Fair (need support)	Use on best soils; avoid light soils

*M refers to Malling; MM means Malling Merton
Source: USDA Farmers' Bulletin No. 1897

II. Obtaining the Trees

A. To insure proper size, variety, and quality, trees should be ordered well in advance from a reliable nursery. Place your order by midsummer (at least September) for fall or spring planting.

B. Order the better-grade plants in given age groups. For example: 1-year whip, 2-year trees, etc.

C. One-year whips are usually recommended because they cost less, suffer less damage from shipping, are usually more vigorous, have lower shipping costs, and plant more easily.

D. Tree Specifications. In ordering nursey stock, the follcwing specifications are suggested for the different fruits:[1]

1. Standard apple and pear varieties: Secure vigorous four to seven foot, one-year old trees (whips), or five to seven foot, two-year old trees which are about three-fourths inch in diameter near the base, and well-branched.
2. Cherries (sour): Order trees budded on Mazzard stock, sturdy one-year whips, four to five feet; or, two-year trees of five to seven feet and a diameter of about three-fourths inch.

[1]Reproduced by permission from MODERN FRUIT SCIENCE, by Norman F. Childers, published by J. B. Lippincott Company, Philadelphia, Pa., 1973.

3. Dwarf trees: The best trees are one or two years old, well-branched with vigorous roots, and labeled for variety/root, or variety/interstock/root.
4. Peaches: Secure vigorous three- to four-foot yearling trees of one-half inch diameter or more. Avoid large, older trees or small, one-year old, weak trees. Vigorous, healthy, "June-budded" trees from Southern nurseries can be used.
5. Plums: Purchase vigorous one-year whips, four to six feet long, or two-year branched trees, four to six feet high.

III. Caring for Trees After Arrival

A. If trees are ordered in advance, they may arrive at a time when they cannot be planted.

B. If trees cannot be planted immediately after arrival they must be heeled in or put in cold storage.
   1. For heeling in:
      a. Dig a trench deep enough to accommodate the root system.
      b. Loosen bundles.
      c. Space trees in the trench.
      d. Add enough water to moisten the soil.
      e. Cover the entire root system.
      f. Press soil around the roots.
      g. Make sure the "heel" is well-drained.
      h. Point the tree tops toward the southwest. This prevents sunscald damage to the tree trunks while heeled in.
   2. For placing trees in cold storage:
      a. Trees should be dormant before storing.
      b. To avoid drying out, tree roots should be covered with material such as sawdust or peat moss.
      c. Keep the temperature around 35° F.
      d. Trees that have been ekpt in cold storage must be watered when planted. Soaking roots in water over night before planting is beneficial.

IV. Land Preparation

A. Regardless of soil type, plowing in strips is recommended for planting trees to allow for good root development.

B. It is recommended that plowing be done in the fall, especially if land is heavily vegetative, to allor for decomposition.

C. If plowing must be done in the spring, it should be done early to allow for soil settlement and absorption of moisture.

V. Tree Planting

A. Time to plant
1. Time of planting is influenced by climate and soil conditions.
2. In Kentucky, fruit trees may be successfully planted in both the fall or early spring.
a. If planted in the fall, a foot high cone of soil should be mounded around the base of each tree. This helps protect the trunk against winter damage, against rabbit injury and against ice damage at the base of trees should water collect there and freeze. The tops of fall- or winter-set trees should not be cut back until early spring.
b. Fall planted trees have longer to get established and usually grow faster than spring planted trees. This is due to greater root development since tree roots will grow all through the winter if the soil is not frozen.
3. By ordering trees and preparing land early, trees can be planted in late February or early March.
4. Early spring planting allows some root growth to start to develop before the tree produces leaves.

B. Planting systems and distances
1. Planting systems
a. The square system is a commonly used system, which is noted for easy installation and ease of manipulation of orchard equipment.
b. The quincunx system is a modification of the square, wherein a filler tree is planted in the center of the square.
(1) The purpose is to obtain greater yields.
(2) Early bearing varieties are placed on the square with filler varieties in the center.
(3) It is more difficult to carry out cultural operations in this system.
(4) Filler trees are removed later.
(5) Nearly half again as many trees are placed as in the square system.
c. Hexagonal system.
(1) Fifteen percent more trees per acre are placed than in the square system.
(2) Cultivation in three directions is possible.
(3) A planting triangle is necessary for layout. Some growers are using a planting board and wire.
(4) Each tree is equidistant from neighboring trees.[2]
d. Hedgerow system.
(1) Allows for efficient use of management.

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[2]Reproduced by permission from APPROVED PRACTICES IN FRUIT PRODUCTION, by Arnold M. Scheer and Elwood M. Juergenson, published by The Interstate Printers & Publishers, Inc., Danville, Illinois, 1964.

(2) A larger number of trees per acre is possible.
(3) This method is adapted to dwarf or semi-dwarf varieties; cash crops may be planted between rows.
(4) Hedgerows are adapted to the use of machinery and equipment for harvesting and spraying.

2. Planting distances
   a. Tree planting distance would be determined by the following factors:
      (1) Planting system
      (2) Size of tree at maturity
      (3) Amount of room needed for machinery and equipment
      (4) Room needed for roads
   b. As a rule of thumb, the following distances are recommended:
      (1) Standard trees: apple - 30'-32' min.
      35'-35' max.
      pear - 25'-30' min.
      30'-30' max.
      peach - 20'-20' min.
      20'-22'
      24'-24' max.
      (2) Semi-dwarf: Set 12' apart in the row with rows 20' apart.
      (3) Dwarf: Set 8' apart in the row with rows 12' apart.

Fruit-Tree Population

Tree spacing	Trees per acre	Yield required per tree to reach production goals per acre: 1000 bu. per acre	1500 bu. per acre	2000 bu. per acre	Years required to reach expected yield
ft.		bu. per tree	bu. per tree	bu. per tree	
30 x 30	48	20.8	31.2	41.7	15 to 20
18 x 24	101	9.9	14.8	19.8	12 to 16
14 x 20	156	6.4	9.6	12.8	8 to 12
12 x 18	201	5.0	7.5	10.0	7 to 12
10 x 16	272	3.7	5.5	7.4	6 to 10
8 x 16	340	2.9	4.4	5.9	5 to 10
6 x 14	519	1.9	2.8	3.8	4 to 8

Source: USDA Farmers' Bulletin No. 1897

C. In planting the trees, the following are recommended practices:
   1. Make sure roots do not dry out.
   2. Make sure the hole is large enough to accommodate the root system.

3. Set standard or seedling rootstock trees to the same depth they were planted in the nursery. In setting trees on dwarfing rootstocks, place the bud or graft union about 2-3 inches above the soil line to prevent scion rooting.
4. If soil is dry, water deeply.
5. Firm the soil around the tree to prevent the root system from drying out.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
1. Tree selection, based upon sound information, is one of the most important phases of fruit growing.
2. The basic planting systems.
3. Importance of good planning.

B. Things to be brought out by class members:
1. Their ideas or experiences with variety selection or tree ordering, caring for trees, preparing land, and tree planting.
2. Their personal preferences to types and varieties of trees.

II. Conclusions

A. When determining what varieties to grow, one should consider the following factors:
1. Pollination effect
2. Adaptation to climatic conditions
3. Returns
4. Dependability
5. Labor load
6. Susceptibility to disease, insects, and cold injury
7. Production life

B. When ordering trees, one should order in advance from a reliable nursery, giving exact tree specifications.

C. If they cannot be planted within one to two days after arrival, trees should be heeled in or put in cold storage.

D. Land should be plowed in strips to allow for good root development.

E. Plowing should be done as early as possible to allow for soil settlement, absorption of moisture, and decomposition of vegetative materials.

F. Trees may be planted in the late fall or early spring, but early spring is generally best for Kentucky.

G. Growers should select the planting system that best fits their situation.

H. Planting distance should be figured carefully to prevent later management problems.

I. Understanding correct planting procedure is imperative to insure a low mortality rate.

III. Enrichment Activities

A. Visit local orchards and check varieties, planting systems, and planting distances.

B. Have class members draw their orchard layout, labeling different varieties.

C. Have each class member practice setting trees, perhaps substituting less expensive trees available locally.

IV. Suggested Teaching Materials

A. References:
1. Modern Fruit Science, pp. 40-64.
2. Approved Practices in Fruit Production, pp. 56-85.
3. Establishing and Managing Young Apple Orchards, USDA Farmers' Bulletin No. 1897, pp. 6-14.
4. Dwarf Fruit Trees, USDA Leaflet No. 407, p. 7.
5. 1972 Peach Variety Performance, U of K Bulletin HO-6.

B. Resource Personnel
1. Local producers
2. Extension fruit specialists
3. For specific personnel, see Vo-Ag Directory of Resource People in Kentucky

C. Audio-visuals
1. Masters
-1 A-E Adapted Tree-Fruit Varieties
-2 Factors in Variety Selection
-3 Characteristics of Different Sized Fruit Trees
-4 Fruit Tree Population
-5 Planting Systems

ADAPTED APPLE VARIETIES

Northern States	Southern and Middle States	Anywhere
Lodi	Lodi	Lodi
McIntosh	Delicious	Early McIntosh
Northern Spy	Golden Delicious	
Rhode Island Greening	Jonathan	
Wealthy	Rome Beauty	
	Grimes Golden	
	Stayman Winesap*	

*Note: Stayman is now in disfavor because of its long-time habit of fruit cracking.

Source: USDA Leaflet No. 407, Dwarf Fruit Trees Selection and Care.

111-3-1A

PEAR VARIETIES

Only pear varieties resistant to fire blight are recommended for planting east of the Rocky Mountains. They include the following:

Maxine (Starking Delicious)

Moonglow

Seckel

Orient

Source: USDA Leaflet No. 407, Dwarf Fruit Trees Selection and Care.

RECOMMENDED PEACH VARIETIES

Weeks Before or After Elberta ripens	Select one or more for each period
5 - 6 before	Garnet Beauty
3 - 4 before	Redhaven, Harken, Reliance (Hardy, Home use)
0 - 1 before	Cresthaven, Madison
With Elberta, about August 15	Redskin

Source: University of Kentucky Peach Variety Performance 1972, by Frank T. Street, W. D. Armstrong, and L. M. Caldwell.

111-3-1C

RECOMMENDED PLUM VARIETIES

Methley

Ozark Premier

French Damson

Stanley Prune

Bluefre

Source: University of Kentucky Bulletin HO-22, Recommended Varieties for the Home Fruit Garden, 1974, W. D. Armstrong.

111-3-1D

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RECOMMENDED CHERRY* VARIETIES

Sour (pie) Cherries: Montmorency (self fruitful)

*Note: Sweet cherries are not generally recommended because of poor tree survival and serious pollination problems.

Source: University of Kentucky Bulletin HO-22, Recommended Varieties for the Home Fruit Garden, 1974, W. D. Armstrong.

111-3-1E

FACTORS IN VARIETY SELECTION

1. Pollination effect. Some varieties must be cross-fertilized before they will set fruit.
2. Adaptation. Select varieties that are adapted to the climatic condition.
3. Expected return. Select high-return varieties.
4. Dependability. Choose varieties that are dependable.
5. Labor requirements. Choose varieties that will spread the labor load.
6. Hardiness. Select varieties that are not susceptible to disease, insect and cold injury.
7. Life expectancy. Select varieties that have a long producing life.

Characteristics of Different-Sized Fruit Trees

Size of Tree	Rootstock*	Anchorage of tree in soil	Adaptability of tree to soil
Full size (standard)	Seedling	Very good	All types
Full size and semistandard (3/4 standard)	MM 104	Very good	All types, but avoid wet sites
Semistandard	MM 111	Very good	All types; tolerates dry or sandy soil
Semistandard	M 11	Good	Most soils are satisfactory; avoid very sandy, heavy, or wet soil
Semistandard and semidwarf (1/2 standard)	MM 106	Very good	All types
Semidwarf	M VII	Good-fair	All types except light soils
Semidwarf and dwarf (1/4 standard)	M 26	Fair-Good (but needs support)	Use on good soils; avoid light soil
Dwarf	M IX	Fair (need support)	Use on best soils; avoid light soils

*M refers to Malling; MM means Malling Merton

Source: USDA Farmers' Bulletin No. 1897

111-3-3

FRUIT-TREE POPULATION

Tree spacing	Trees per acre	Yield required per tree to reach production goals per acre: 1000 bu. per acre	1500 bu. per acre	2000 bu. per acre	Years required to reach expected yield
ft.		bu. per tree	bu. per tree	bu. per tree	
30 x 30	48	20.8	31.2	41.7	15 to 20
18 x 24	101	9.9	14.8	19.8	12 to 16
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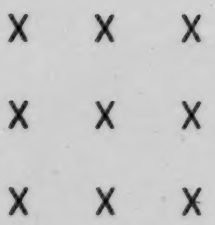
8 x 16	340	2.9	4.4	5.9	5 to 10
6 x 14	519	1.9	2.8	3.8	4 to 8

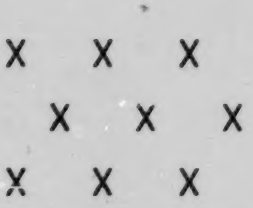
Source: USDA Farmers' Bulletin No. 1897

PLANTING SYSTEMS

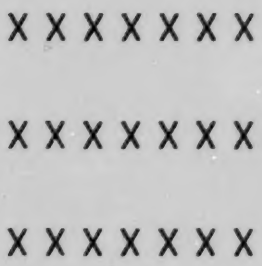


Square

Quincunx



Hexagonal



Hedge Row

Source: Approved Practices in Fruit Production, p. 77.

111-3-5

Lesson 4

PROPAGATION BY GRAFTING AND BUDDING

Objective -- To develop the effective ability of orchardmen to graft and bud fruit trees.

Problem and Analysis -- How may we propagate fruit trees by grafting and budding?

-Propagation terms
-Time to graft
-Selection and care of scion wood
-The common grafts
-Time to bud
-Collecting budding materials
-Kinds of budding

Content

I. Propagation Terms

A. In order to be successful with grafts and buds one should have a basic knowledge of common propagation terms.

B. Listed below are common terms and definitions.
1. Grafting. Joining parts of plants together in a manner that they will unite and continue growth as one plant.
2. Budding. Commonly called bud grafting, this involves grafting a single bud of one plant to another plant.
3. Scion. That part of the plant that is grafted onto another plant.
4. Stock. The plant in which the scion is grafted.
5. Root stock. That part of the tree that makes up the root system on the grafted portion.

II. Time to Graft

A. Grafting may be done in late March at the time the tree begins to break dormancy.

B. Grafting may be done successfully through early May or the bloom period.

III. Selection and Care of Scion Wood

A. Scion wood should be collected during the winter months, when the wood is dormant.

B. Care should be taken in the selection of scion wood to insure quality grafting materials.

C. When selecting scion wood, one should keep the following in mind:
1. Make sure wood is dormant.
2. Select wood free from insect or disease damage.
3. Select wood that has made good growth the past season.
4. Select wood that grew the previous year.
5. Select wood that is 1/4" to 3/8" in diameter, containing healthy buds.

D. After wood is collected, it must be stored either by burying or placing in cold storage.

E. When burying:
1. Wrap wood heavily in paper.
2. Bury wood in a horizontal position at least two feet deep.
3. For best results, bury wood on the cold side of a building.
4. Wood should be buried in a well-drained area.

F. When placing the scion wood in cold storage:
1. Pack wood in damp sawdust in a box or moisture-tight plastic.
2. During storage, keep moisture very, very low.
3. Keep temperature around 35° F.

IV. The Common Grafts

A. The following grafts are the ones most commonly used:
1. Cleft graft
2. Approach graft
3. Whip graft
4. Bark graft (preferred in Ky. for apples, pears and nut trees)
5. Bridge graft

B. Refer to transparency masters for specific information for each graft.

V. Time to Bud

A. Budding is done in the late summer, usually during August and early September. It should be done at a time when the bark slips off the wood easily.

B. Peaches are sometimes "June budded" in May or the first half of June; however, it is so specialized a procedure it is only recommended for professionals.

VI. Collecting Budding Material

A. Cut budsticks from vigorous current-year shoots.

B. Remove leaves from budsticks at once, by cutting leaf stems 1/4 inch out from buds to help prevent drying out.

C. Use bud wood within a few days after cutting.

D. Always keep bud wood moist and cool until used.

E. Very slightly moist newspaper makes good holding media.

VII. Kinds of Budding

A. There are several different budding methods. Among these are the following:
1. T - bud
2. Chip bud
3. Plate bud
4. I - bud
5. Flute bud
6. Patch bud

Note: Patch, flute, and I buds are mostly used on nut trees.

B. The "T" method of budding is the one most commonly used.

C. Refer to transparency masters for specific procedures.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
1. Grafting and budding operations may be learned by anyone desiring to do so.
2. Techniques of budding and grafting.

B. Things to be brought out by the class members:
1. Their basic knowledge of grafting and budding operations.
2. Their ideas on reasons why an orchardman should know how to graft and bud fruit trees.

II. Conclusions

A. Grafting or budding is cheaper for the orchardman than replacing the entire tree.

B. There are many different methods of budding and grafting. One should select methods that best fit his needs.

C. In order to graft or bud successfully one must understand the proper selection and care of grafting or budding materials.

D. Grafting or budding is not a simple operation; it requires patience, skill, and practice.

E. Proper timing is a critical factor involved in grafting or budding, but grafting may be done in late March through May, and budding through August and early September.

F. Grafting and budding operations require advance planning; therefore, an orchardman should schedule these operations yearly. An alternative used by many good orchardmen is to buy trees already budded or grafted.

III. Enrichment Activities

A. Visit nearby orchards in which grafting and budding operations have been performed.

B. Invite an orchardman, a specialist, or a nurseryman to demonstrate grafting and budding techniques to class members.

C. Have class members practice both operations.

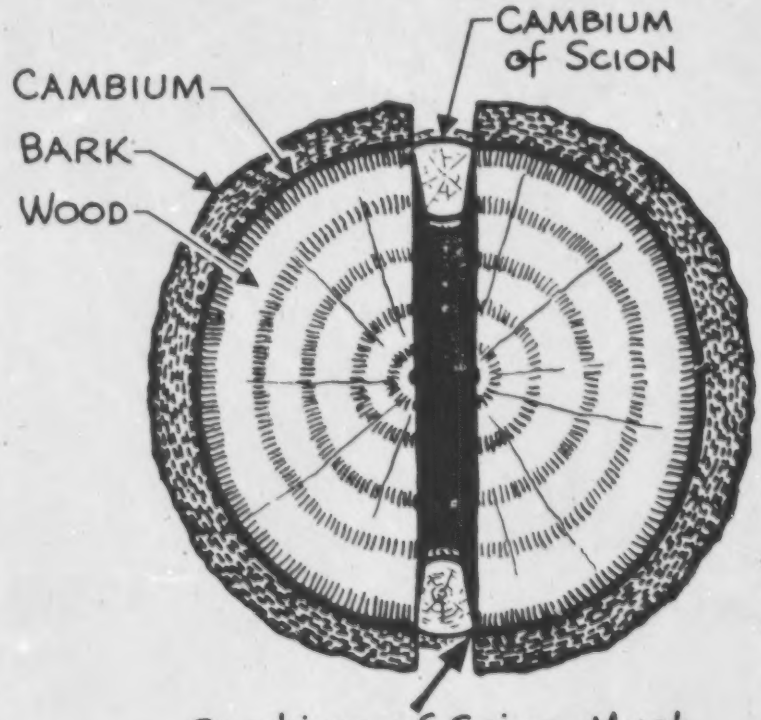
IV. Suggested Teaching Materials

A. References for lesson 4
1. Modern Fruit Science, pp. 126-162.
2. Approved Practices in Fruit Production, pp. 87-126.
3. Grafting and Budding Fruit Trees, Extension Bulletin 379, College of Agriculture, Rutgers University.

B. Resource personnel
1. Local orchardmen
2. For specific personnel, see Vo-Ag Directory of Resource People in Kentucky.

C. Audio-visuals
1. Masters
-1 Matching the Cambium Layers
-2 Steps in Making a Cleft Graft
-3 Steps in Making a Bark Graft
-4 The Whip or Tongue Graft
-5 How to Make a Bridge Graft
-6 Kinds of Budding

MATCHING the CAMBIUM LAYERS



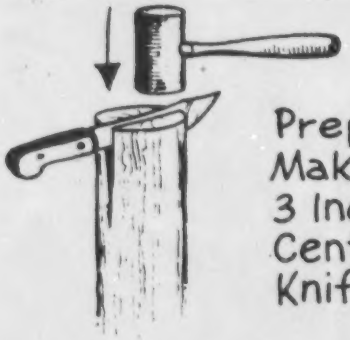
Cambium of Scion Must Make Contact With Cambium of Stock.

Improper Placement of Scion Prevents Good Cambium Contact.

Incorrect Shaping of Scion Prevents Good Cambium Contact.

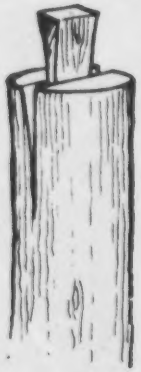
T. VANTREESE, INST. MATL. LAB., U.K.

STEPS IN MAKING A CLEFT GRAFT



1. Prepare Stub by Making a Split 2 or 3 Inches Down The Center With A Heavy Knife or Grafting Tool.

2. Choose 2 Scions 3-4 Inches Long And Cut Into Wedges. (Outer Side of Wedge Must Be Wider Than Inner Side) Two or Three Buds Should Be On Each Scion.



SPREAD STUB

INSERT SCIONS

REMOVE WEDGE – And WAX

3. Spread Stub Open With Wedge Shaped Object & Insert Scions. Position So That The Cambium Layers Match - Then Remove Wedge. Scions Will Be Held Tightly By The Pressure of The Stock. Thorough Waxing of The Graft is Essential. (The Entire End of The Stub... The Splits Down The Side... And The Ends of The Scions)

11-4-2

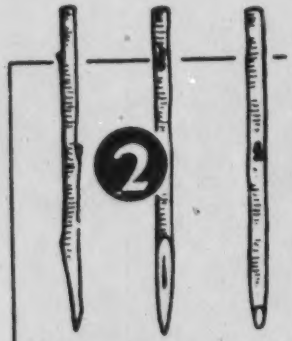
T. VANTREESE, INST. MATLS. LAB., U.K.

STEPS IN MAKING A BARK GRAFT

1

Make 2 Knife Cuts Through Bark About 2" Long And As Wide As The Scion To Be Used.

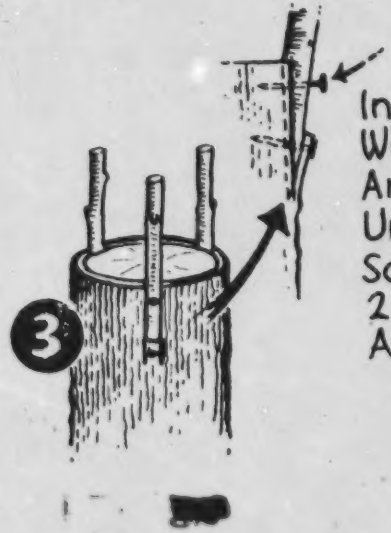
Lift This Strip of Bark And Cut Off Upper 2/3, Leaving A Small Flap At At The Bottom.



2

Cut Scions As Shown With A Long Taper On One Side And A Short Cut On The Opposite.

Side - Back - Front



3

Insert Scions Into Slots In Bark With Long Tapered Side Inward - And The Short Taper Slipped Under The Remaining Flap. The Scions Must Be Secured With 2 Nails, One Through The Flap And One Above It.

4

...Then The Grafted Stub Is Ready To Be Waxed.

11-4-3

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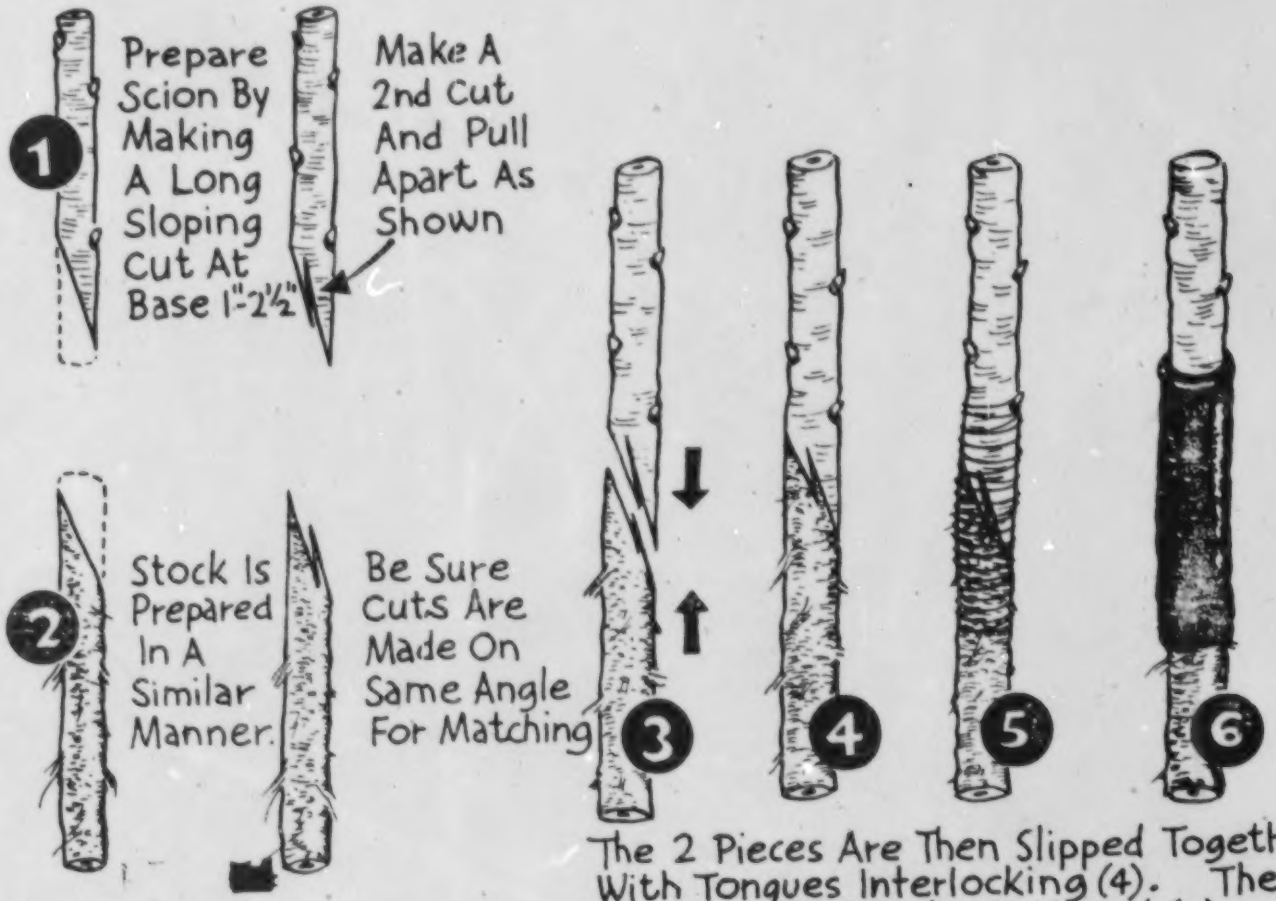
The WHIP or TONGUE GRAFT


1
Prepare Scion By Making A Long Sloping Cut At Base 1"-2½"
Make A 2nd Cut And Pull Apart As Shown
2
Stock Is Prepared In A Similar Manner.
Be Sure Cuts Are Made On Same Angle For Matching
3
4
5
6
The 2 Pieces Are Then Slipped Together With Tongues Interlocking (4). The Graft Is Then Tied (5), And Waxed (6).

NOTE: On grafts made to above ground limbs, use waxed tape or twine; cut the binding later

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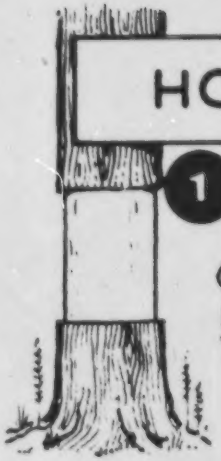
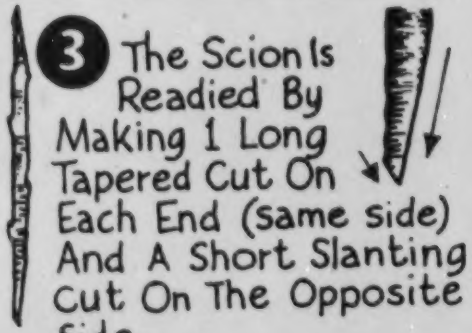
HOW TO MAKE A BRIDGE GRAFT

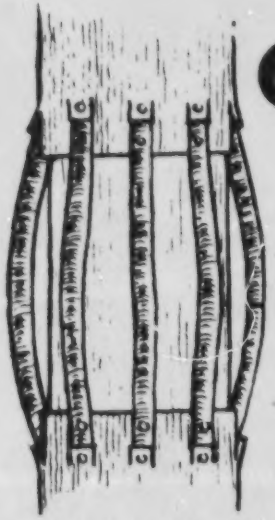


1 Remove All Dead Or Damaged Bark Down To Healthy Tissue.

2 Make Cuts 2" or 3" Apart For Placement of Scions. Prepare These Cuts As If Making A Bark Graft. (With Flap.)



3 The Scion Is Readied By Making 1 Long Tapered Cut On Each End (same side) And A Short Slanting Cut On The Opposite Side.



4 Place Scions In Slots And Under Flaps. The Long Tapered Cut Will Face Inward. Scions Must Be In A Position With Buds Turned "Up" For Proper Growth. (These Buds May Be Trimmed Off.) After Scion Is Put In Place, Nail Each End Securely And Cover With Grafting Wax.

NOTE: Do bridge grafting early in the spring, as soon as the bark will slip and can be removed from the slots.

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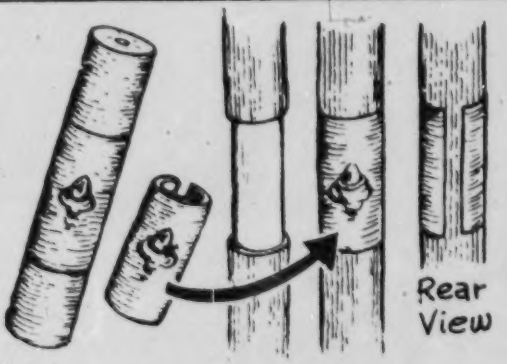
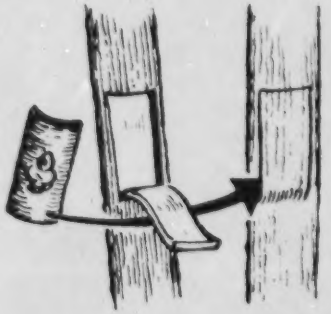
KINDS OF BUDDING

A PATCH BUD

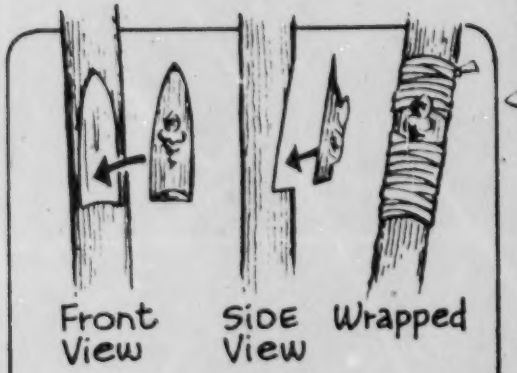


A FLUTE BUD

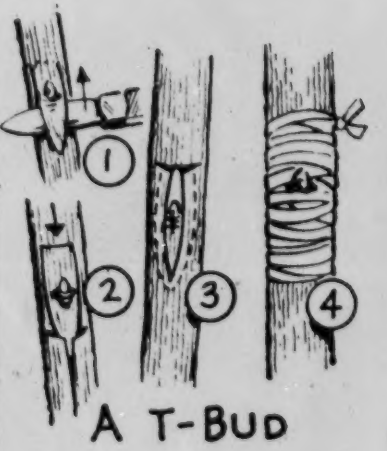
AN I-BUD



A PLATE BUD



A CHIP BUD



A T-BUD

111-4-6

Lesson 5

PRUNING FRUIT TREES

Objective -- To develop the effective ability of growers to prune fruit trees.

Problem and Analysis -- How should one prune fruit trees?

- -The importance of pruning
- -When to prune
- -Which species to prune
- -Pruning equipment
- -Pruning cuts
- -Pruning young trees
- -Pruning bearing trees
- -Treating pruning wounds

Content

I. The Importance of Pruning

A. Pruning operations involve the removal of undesirable or surplus growth.

B. The following are reasons for pruning:
1. To control or direct the growth of the fruit tree.
2. To improve quality, color, and size of fruit.
3. To insure fruit quantity.
4. To insure fruit-bud differentiation for future years.
5. To facilitate cultivation, insect and disease control, and harvesting.
6. To restore a balance between root and top growth.
7. To set a balance between growth and fruit production.
8. To repair or correct damaged parts of fruit trees.
9. To insure a pleasing artificial form.
10. To make-up for transplanting.
11. Physical reasons
    a. To thin out dense growth to let in air and light.
    b. To reduce breakage due to harsh weather.

C. Pruning operations are used to train trees and to develop branches for fruit. These should be considered as two separate operations.

II. Deciding When to Prune

A. Most pruning should be done in the late dormant season (no leaves) for the following reasons:

1. Branches are easily seen.
2. There is less danger of pulling the bark away from around pruning wounds.
3. Dormant-season pruning has less dwarfing effect on trees.

B. One should prune in the early spring in freezing climates such as in Kentucky.

C. In severe freezing climates, pruning in November or December is more hazardous than pruning late in the dormant season, since it may result in serious freezing injury to the trees.

D. The time to prune depends also upon the age of the tree and the purpose of pruning.
1. Young fruit trees can be most effectively trained by summer pruning.
2. Trees without vigor should be pruned in the winter, since dormant pruning is far more invigorating.
3. Summer pruning is best if shaping the young tree is the main goal.
4. To obtain maximum yield, dormant pruning is best.

III. Which Species to Prune

A. All fruit species benefit from pruning, and pruning is essential to the production of good crops.

B. Peaches should be pruned annually and apples at least every other year.

C. Cherries and plums are not pruned as frequently, and when done only large, old branches are cut out.

D. Pear blight is often encouraged by annual pruning. Prune pears only lightly.

IV. Pruning Equipment

A. Most pruning is done by hand, using shears, saws and ladders.

B. The following are implements used in pruning:
1. One-hand pruning shears are of two types:
   a. Anvil
   b. Hook and curved blade
2. Lopping shears (two-hand pruners)
   a. Blade-and-anvil type, which has a draw-in slicing action.
   b. Hook-and-blade holds the branch while the blade slices through it.
3. Pruning saws (used to cut branches thicker than 1 inch).
   a. Tree surgery saw (has a 2-inch wide blade)
   b. Bow saw
   c. Curved saw with rigid handle
   d. Folding saw

e. Speed saw with rake teeth
f. Speed saw with lance teeth
g. Folding saw with grip handle
h. Pole saw

4. Pole pruners (trombone type)
5. Power tools
6. Surface-forming tools

C. Although good tools in good condition are very valuable, the skill of the operator in using the tools is much more important.

D. Tools should be strong and sharp, but light.

V. Pruning Cuts

A. It is best to get a good, clean cut for appearance as well as faster healing.

B. Several common cuts are:
1. Cutting at the crotch (the angle of one branch to another at their common base).
2. Heading-back. This cut involves cutting back a branch or shoot, thus thickening growth.
3. Thinning out. This cut is used to open the center of the tree and admit more sunshine; it involves removing the entire shoot or limb.
4. Cutting to lateral branches. A limb is shortened by cutting to a lateral branch, making the cut in line with the side branch.
5. Detailed pruning. This consists of the removal of small branches.

VI. Pruning Young Trees

A. At planting (do not head back fall-planted trees until spring):
1. Head back most fruit trees to 24-30 inches (or even 40 inches, if a very tall specimen).
2. Apples should be cut back to 28-30 inches.
3. Primaries can often be selected on some trees at this time. Cut stubs to 6 inches length.
4. Some growers now leave all limbs on young apples trees, for the first 2 years.
5. Peaches are usually trained to an open center form.
6. Apples, pears, cherries and plums are usually trained to modified leader form.

B. First summer pinching (peaches)
1. Select 3 primaries and pinch tips off of other shoots. This puts all growth into the untipped primaries. This pinching usually needs to be repeated.

C. First dormant pruning (apples)
1. Select primaries.

2. Try to achieve an even distribution around trunk, 6-8 inches apart.
3. The bottom primary on apples should start at 18-20 inches from the ground.
4. Primaries should be at an approximately 60°-90° angle from the vertical.

D. Heading scaffolds
   1. Head primary scaffold branches.
      a. Chest high
      b. Leave 15-30 inches or more
      c. When greater growth has occurred, leave longer
      d. Make horizontal cuts shorter
      e. Even cutting is bad; leave top scaffold branches the longest
      f. Height of the top should be left longer
      g. Cut whorls (cots) off

E. Second year
   1. Remove laterals up to the secondaries.
   2. Select five to seven secondaries at shoulder height.

F. Third and subsequent dormant pruning
   1. Thin out and eliminate crossing or interfering branches.
   2. Remove watersprouts.
   3. Encourage fruit spurs on larger branches.
   4. Open the center to admit light.
   5. Head at desired height.
   6. Prune for production of good-quality, large-sized fruit.[1]

VII. Pruning Bearing Trees

A. Collect supplies.
   1. Shears, hand clippers
   2. Oil, file, hone
   3. Saw, ladder
   4. Tree seal, Bordeaux paste, raw linseed oil, white lead or other approved material for specific variety

B. Decide which method of pruning to use.
   1. Leader type
      a. At present, increasingly used in compact and closely planted dwarfing apple types.
      b. The topmost branch is encouraged to predominate.
      c. The tree becomes pyramid-shaped.
   2. Modified leader type
      a. A mechanically strong framework results.
      b. The topmost limb is encouraged.
      c. Then a cut is made to a lateral.
      d. This results in four to six well-spaced scaffolds.
      e. This technique is used in some apple trees.

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[1] Approved Practices in Fruit Production, pp. 147-150.

3. "Open center" type
   a. This method is most common in California.
   b. The uppermost branch is left longest to avoid choking out.
   c. The center is kept open.
   d. Wide angles and strong crotches result.
   e. There is a weakness in the system if pruning is not done properly.

VIII. Treating Pruning Wounds

A. Wound treatments depend upon local conditions.
   1. In foggy climates, pruning cuts should be disinfected as soon as the wood has dried a little, cut before cracks have formed.
   2. In areas where the air is dry, pruning wounds seldom need disinfection.

B. To prevent the entrance of rot-causing fungi, large wounds over three inches in diameter should be covered with some protective substance.

C. Bordeaux is a good disinfectant and wound covering.

D. White-lead paint mixed with raw linseed oil has been used successfully for wound coverings.

E. Asphalt paint, grafting wax, and shellac can also be used.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Teacher contribution:
   1. Proper management of an orchard involves good pruning practices.
   2. In order to do a good job of pruning, one needs the necessary equipment.
   3. Through knowledge of the pruning operation is vital.

B. Things to be brought out by the class members:
   1. Their ideas on why pruning is necessary.
   2. Their ideas and knowledge of pruning procedures.
   3. Their knowledge of pruning equipment.

II. Conclusions:

A. Pruning is an important phase of tree fruit production, essential to the production of good crops.

B. The time to prune depends upon the age of the tree and the purpose of pruning; however, most pruning should be done in the dormant season, late winter and early spring.

C. All tree-fruit species benefit from pruning.

D. Most pruning is done by hand, using shears, saws and ladders; however, different types of pruning equipment are available.

E. There are many different kinds of pruning cuts; for appearance and faster healing, a good clean cut is necessary.

F. In pruning young trees, one should have a step-by-step procedure to follow.

G. In pruning bearing trees, one should select the method that best fits his needs.

H. Heavy cutting, irrigation, and fertilization may cause decreased fruit production.

I. A lack of pruning, soil moisture, and nitrogen in bearing trees will result in new-wood growth and overproduction.

J. If young trees are severely pruned, the tree will fail to grow and bear as much as one less severely pruned.

K. Every orchardman should select his own methods of cultivation, irrigation, pruning with the idea of securing a proper balance between vegetative growth and fruitfulness.

L. Pruning is one of the most important factors in determining the balance between carbohydrate and nitrogen supply.

M. If poor drainage or rising water table results in restricted root development, pruning must be more severe.

III. Enrichment Activities

A. Invite local orchardman to discuss and demonstrate pruning procedures.

B. Visit local orchards during the pruning season and observe pruning procedures.

C. Visit a class member's orchard and have class members try their hand at pruning.

IV. Suggested Teaching Materials

A. References for lesson 5

1. Modern Fruit Science, pp. 66-97.
2. Approved Practices in Fruit Production, pp. 139-163.
3. Sunset Pruning Handbook, pp. 4-12.
4. Make Friends With Your Fruit Trees, pp. 40-45.
5. Fruit Growing, pp. 92-107.
6. Training the Spur-Type Apple Tree. Misc. 317. University of Kentucky.

B. Audio-visuals
1. Masters
-1 Reasons for Pruning
-2 Methods of Pruning (Training)Fruit Trees

REASONS FOR PRUNING

1. To control or direct the growth of the fruit tree.
2. To improve quality, color, and size of fruit.
3. To insure fruit quantity.
4. To insure fruit-bud differentiation for future years.
5. To facilitate cultivation, insect and disease control, and harvesting.
6. To restore a balance between root and top growth.
7. To set a balance between growth and fruit production.
8. To repair or correct damaged parts of fruit trees.
9. To insure a pleasing artificial form.
10. To compensate for transplanting.
11. To thin out dense growth to let in air and light.
12. To reduce breakage due to harsh weather.

METHODS OF TRAINING FRUIT TREES

1. Leader

2. Modified Leader
(apples, pears, cherries, and plums)

3. Open Center
(peaches)

111-5-2

Lesson 6

MANAGING THE ORCHARD SOIL

Objectives -- To develop the effective ability of orchardmen to properly manage the orchard soil.

Problem and Analysis -- How should we manage the orchard soil?

-Objectives of a good soil management program
-Management for young and dwarf trees
-Management for low-density bearing trees
-Orchard cover crops
-Orchard fertilization

Content

I. Objectives of a Good Soil Management Program

A. Good soil management practices are essential for the success of an orchardman.

B. A good orchard soil-management program will accomplish the following:
1. Control soil erosion
2. Provide an adequate moisture supply
3. Maintain organic-matter level of the soil
4. Improve the availability of necessary plant nutrients
5. Maintain good soil structure

II. Soil Management for Young and Dwarf Trees

A. A good orchardman will strive to secure 20-30 inches of terminal growth each year on young trees.

B. In order to obtain this rapid growth, herbicides or cultivation will be required.
1. Use of herbicides
a. The most common herbicides used in the orchards are sinbar and paraquat. (See Ky. Bulletin ID-22)
b. Herbicides are applied around the base of the trees about five feet on each side.
c. On slopes, herbicides may be more practical than cultivation.
2. Use of cultivation
a. Orchards located on sites with greater than 10% slopes should be kept under continuous sod cover, such as Kentucky 31 Fescue.

b. Beginning in the spring, soil should only be cultivated enough to keep down excessive weed growth.
c. After the bloom period, the area should be sown in a cover crop; this includes orchards located on less than 10% slope.

III. Soil Management for Low-Density Bearing Trees

A. Most orchardmen agree that continuous cultivation with cover crops throughout the life of the orchard is detrimental to the soil and the fruit trees.

B. A program generally recommended for bearing trees is the sod mulch. (The orchard sod cover is cut and placed under the fruit trees.)

C. Mulching has the following advantages:
1. Stabilizes soil moisture.
2. Stabilizes temperature beneath the soil.
3. Many necessary plant food elements become more available.
4. Soil aeration is better beneath the mulch.
5. Less damage to falling fruit occurs, due to the cushioning effect of the mulch.

D. Disadvantages of the mulching system:
1. The mulching material could become a fire hazard during dry weather. (Extra caution should be taken during dry periods.)
2. Mulch has a tendency to harbor diseases, insects, and rodents, thus it may be necessary to buy extra chemicals and baiting materials to combat these pests.

IV. Orchard Cover Crops

A. Cover crops should be used between the tree rows where soils are sandy or low in organic matter.

B. On slopes, cover crops should be replaced with a sod crop such as Kentucky 31 Fescue and chemical control of weeds around the trees.

C. Cover crops have the following advantages:
1. Maintain the soil humus content.
2. Protect soil against erosion.
3. Return nutrients to the soil.
4. Improve workability of the soil.
5. Prevent leaching of mineral nutrients over winter months.

D. Summer cover crops
1. Sudan grass
2. Buckwheat
3. Soybeans

4. Cowpeas
5. Millet
6. Lespedeza

E. Winter cover crops
1. Wheat
2. Oats
3. Rye
4. Winter vetch
5. Alfalfa

V. Orchard Fertilization

A. Fertilization will vary with soil and climatic conditions.

B. Local recommendations may be secured from the local county Extension agent.

C. Refer to the master at the end of the lesson for deficiency symptoms.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
1. Soil management is crucial to ultimate success in the orchard business.
2. Expected results of a sound soil-management program.
3. Types of cover crops available.

B. Things to get from the class members:
1. Ideas for proper soil management.
2. Experience with herbicides, mulches, cover crops, and cultivation.

II. Conclusions

A. A sound, long-term plan for soil management is a must for any orchard. It must be carried out to maximize profit.

B. An orchardman should carefully consider each system and decide whether mulching, sod, cover crops with cultivation, herbicides, or cultivation is best for his specific situation.

C. Provide complete fertilizers; secure recommendations from the county extension agent for trace nutrients.

III. Enrichment Activities

A. Have a successful orchardman or Extension horticulturist speak to the group.

B. Visit and observe different types of soil management systems.

C. Develop an experimental orchard plot.

IV. Suggested Teaching Materials

A. References
1. Establishing and Managing Young Apple Orchards, Farmer's Bulletin 1898, USDA.
2. Dwarf Fruit Trees - Selection and Care, Leaflet 407, USDA.
3. Chemical Control of Weeds in Vegetable and Fruit Crops in Kentucky, UK Bulletin ID-22, pp. 10-11.
4. Modern Fruit Science by Childers, pp. 99-126.
5. Approved Practices in Fruit Production, pp. 165-179.
6. Fruit Growing by Schneider and Scarborough, chapter 2.

B. Resource Personnel
1. Extension soil specialists
2. Experienced orchardmen
3. For specific personnel, see Vo-Ag Directory

C. Audio-visuals
1. Masters
-1 Values of Sound Soil Management
-2 Cover Crops for the Orchard
-3A,B Deficiency Symptoms

VALUES OF SOUND SOIL MANAGEMENT IN THE ORCHARD

1. Controls erosion
2. Helps insure adequate moisture supply
3. Maintains organic-matter level
4. Improves nutrient availability
5. Maintains good soil structure

RECOMMENDED COVER CROPS FOR THE ORCHARD

Summer Crops	Rate/Acre
Sudan grass	25 - 30 lbs.
Buckwheat	1 bu.
Soybeans	1/2 bu.
Cowpeas	1 1/2 - 2 bu.
Millet	25 - 40 lbs.
Lespedeza	20 - 25 lbs.

Winter Crops	Rate/Acre
Wheat or Barley	1 - 1 1/2 bu.
Oats	1 1/2 bu.
Rye	1 1/2 bu.
Winter vetch	1 bu.
Alfalfa	20 lbs.

Note: On steep slopes, a sod crop such as Kentucky 31 Fescue should be used, along with chemical weed control.

Source: Fruit Science

DEFICIENCY SYMPTOMS IN THE ORCHARD

Nitrogen Deficiency

Short and thin shoots
Small, erect, light green or yellowish leaves
Early leaf drop
Red leaf veins in autumn
Small, highly colored fruit
Light fruit crop

Phosphorus Deficiency

Dark, grayish-green foliage and stems
Restricted root growth
Small leaves
Dead buds
Dull, soft fruit
Reduced yield

Potassium Deficiency

Marginal and tip burning of leaves
Lateral buds fail to unfold
Short thin shoots
Reduced size, color, and quality of fruit

Source: Fruit Science

Trace Element Deficiency

Magnesium - leaf chlorosis and interveinal scorch; early fruit drop

Calcium - restricted root growth, brown root tips, death of shoot tips, browning and spots in leaf centers

Boron - rough, cracked, cork-like bark; dead leaves, leaf rosettes; early fruit fall

Zinc - small, mottled, misshapen leaves; fewer buds, small, misshapen fruit

Iron - leaves at shoot tips straw yellow or yellowish green, poorly colored, flat-tasting fruits

Manganese - leaves have "herringbone" appearance (light and dark green); reduced yield

Sulphur - even yellowing of tip leaves

Copper - shoot die-back; black or yellow tipped leaves; reduced, poor quality fruit; early leaf drop

Molybdenum - occurs with low pH; yellowing of leaves

Source: Fruit Science

111-6-3B

Lesson 7

FRUIT THINNING

Objective -- To develop the effective ability of growers to thin fruit.

Problem and Analysis -- How should we thin fruit?

-Reasons for thinning
-Which species need thinning
-Time to thin
-Amount to thin
-Thinning methods

Content

I. Reasons for Thinning

A. The chief goal of thinning is to permit the tree to mature as large a crop as possible and yet conserve sufficient nutrients and carbohydrates for good shoot and spur growth.

B. An important fact to remember is that most fruit trees "set" more fruit than they can mature with good sound quality.

C. Thinning reduces the number of fruits per tree.

D. Thinning improves fruit size by reducing competition between the fruit and other growing parts.

E. Thinning increases fruit color.
   1. Limb propping helps expose fruit to the sun for better coloring.
   2. Fruit on dwarfed trees receive better light and are colored better than on larger trees.

F. Thinning improves physical conditions of trees by reducing breakage.

G. Thinning allows a grower to cull undesirable fruit.

H. Thinning reduces disease- and insect-injured fruits.
   1. Spread of insects and diseases can be checked by removing injured fruits which may rub against healthy fruit.
   2. Growers have an early opportunity to remove misshapen specimens injured by insects and diseases.

I. Thinning will improve the salability of the fruit.

II. Which Species Need Thinning

A. Peaches, nectarines, shipping plums, and apples should be thinned to meet market demands.

B. Fruits of the pear, sour cherry, and prune show benefit from thinning, although it is not practiced on them as on the others.

III. Time to Thin

A. Fruits should be thinned as early as practicable when the greatest effect can be expected from a minimum of effort and cost.

B. Other orchard work should be planned so that it may fit into fruit thinning; since fruit thinning needs exact timing.

C. Late season thinning is not very effective in obtaining the desired results.

D. With peaches, thinning too early may result in split-pit and gummy fruit.

E. For drupe fruits (peach, plum, cherries), thinning should be done at the time the fruits are not increasing rapidly in size.

F. For peaches, thinning should be done around mid-May, since the fruit is about half-grown and is readily removed the trees by hand, or by pole thinning or by using the "Kentucky Bumper."*

G. For apples, thin chemically when fruit is 3/8" - 7/16" in diameter. Hand thinning is done after the May drop or June drop is over.

IV. Amount to Thin

A. If the fruit is relatively small, as compared to other seasons at the time of thinning, a heavier job of thinning will be necessary to bring the fruit up to the size limit.

B. If a grower expects to market a portion of his crop for fresh use, he must thin very heavily to secure early size.

C. Important factors to consider in the amount of thinning:
1. Whether fruit tends to be grouped in clusters.
2. Heavy set on just a few limbs. Make room for fruit growth and prevent limb breakage.

NOTE: *-The "Kentucky Bumper" is a hand-operated "mall" with a sturdy staff padded on one end by foam rubber and innertube rubber. Small fruits are "bumped" off by sharp blows to 1" to 2" limbs with the well-padded device.

3. Poor soil. Trees show low vigor or low leaf area per fruit.
4. Older trees. Fruit on older trees in some sections tends to become smaller and then needs more thinning than that on young trees.
5. Water availability for season.
6. A cull is never a marketable fruit.
7. Effects on cover crops (chemicals, discarded fruit).

D. If the grower is looking towards a canning or drying outlet where small fruits are readily accepted and he will have a week to 10 days longer before harvest, he can leave more fruits on the trees.

V. Thinning Methods

A. Chemical sprays (not as effective in Kentucky as elsewhere)
1. Chemicals such as clinitrocreasol or dinitrophenol compounds are applied at 85 to 90 per cent full bloom.
2. Blossom spray thinring has the danger that since it is applied at the bloom time, frosts may still occur and reduce the set of fruit after thinning.
3. Dinitro spray compounds are reactivated by rain, therefore, if rainfall occurs 1-2 days after spraying, overthinning may result.
4. The average cost per acre for hand thinning is $275; for chemicals it is $5-$10.
5. Factors affecting results.
a. Timing is a critical factor in the thinning process; if timing is off, poor results will occur.
b. Concentration of spray mixture. A grower should always follow recommended mixing procedures in order to obtain the best results.
c. Kind and variety of fruit. Chemical thinners, in general, are safer and more dependable with varieties that tend to set heavy crops.
d. Weather conditions. Weather conditions, both before and after spraying, will affect the spraying results.
e. Tree vigor. Better results occur from trees with normal vigor.
f. Number of applications. The more the applications, the more the thinning. Before applying a second application there should be enought time allowed to evaluate the first spray.

B. Hand thinning
1. In this method, excess fruit is removed by hand-picking.
2. Fruit should be thrown away from the tree.
3. This method is slow and expensive.

C. Mechanical thinners
   1. Mechanical tree shakers are also used in the fruit thinning process; these are fast, but expensive labor-saving devices.
   2. The "Kentucky Bumper" has shown great benefits in thinning peaches.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
   1. Fruit thinning is essential to the success of an orchardman.
   2. One must determine the amount of thinning needed and at what time needed.
   3. One must evaluate and select methods of thinning.

B. Things to be brought out by the class members:
   1. Their ideas of the following:
      a. Reasons for thinning
      b. Species to thin
      c. Time to thin
      d. Thinning methods
   2. Their knowledge of chemical thinners.

II. Conclusions:

A. Fruit thinning is a must to insure quality fruit production that will meet market demand.

B. Peaches, apples, plums, and nectarines should be thinned.

C. For drupe fruit, thinning should be done at the time the fruits are not increasing rapidly in size.

D. For peaches, thinning should be done around mid-May.

E. For apples, chemical thinning is done when fruit is 3/8" to 7/16" in diameter.

F. If a grower expects to market a portion of his crop for fresh use, he must thin very heavily to secure early size.

G. There are basically three methods of thinning:
   1. Chemical sprays (not as effective for Kentucky as in other states)
   2. Hand thinning
   3. Mechanical thinning

III. Enrichment Activities

A. Visit local orchard during thinning season.

B. Invite fruit specialist to talk to class.

IV. Suggested Teaching Materials

A. References
1. Modern Fruit Science, pp. 146-161.
2. Approved Practices in Fruit Production, pp. 203-219.
3. Fruit Growing, pp. 174-175, 193, 207-209, 227.
4. Extension Bulletin 407, Rutgers University, 1973, pp. 5, 32, 47.

B. Resource Personnel
1. Consult local producers
2. Consult fruit specialists
3. For specific personnel see Vo-Ag Directory of Resource People in Kentucky.

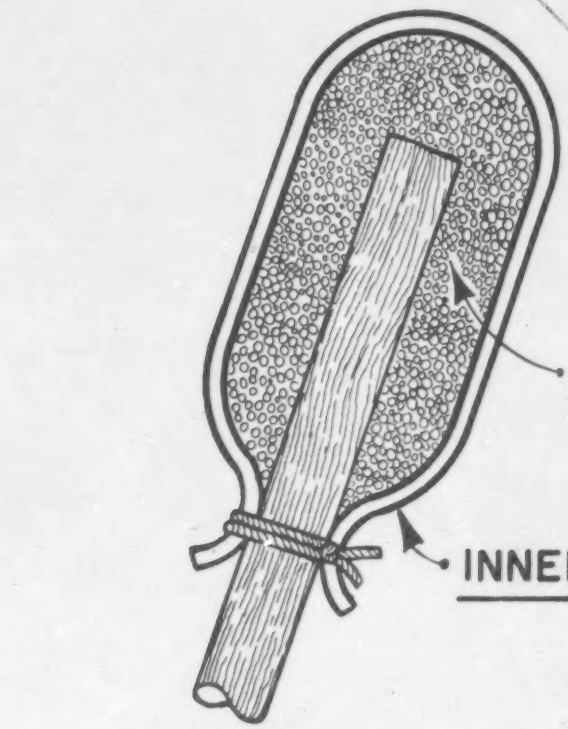
C. Audio-visuals
1. Masters
-1 Reasons for Thinning
-2 The "Kentucky Bumper"
-3 Chemical Thinning of Apples
-4 Thinning of Other Fruit

REASONS FOR THINNING

1. Increases total yield of market fruit
2. Improves quality of fruit
   - size
   - color
   - taste
3. Improves shoot and spur growth
4. Reduces limb breakage
5. Reduces cull fruits
6. Allows more thorough spray coverage
7. Reduces harvest and handling costs
8. Induces annual crops of fruit

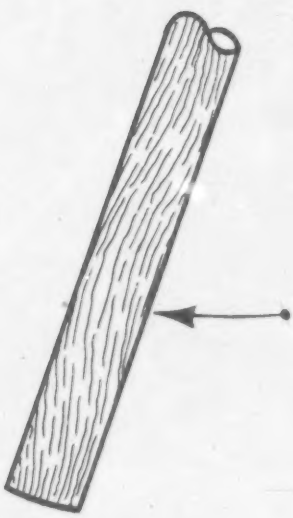
Source: Fruit Science.

"THE KENTUCKY BUMPER"



FOAM PAD

INNER TUBE COVER



2-3" POLE OF LENGTH SUITABLE TO THE SIZE TREE IN THE ORCHARD

111-7-2

R.GILMORE CDC UK 1360-1 6TH

CHEMICAL THINNING OF APPLES

Varieties	Days after full bloom	Materials and rates per 100 gallons
Lodi, Melba, Raritan Starr, Summer Pippin, Wealthy, Yellow Transparent	Petal fall	NAD: 40-50 p.p.m.
	OR	OR
	4-8	NAD: 25 p.p.m. plus Tween 20: ½ pt./100 gal.
		OR
	14	Sevin 50% WP 1 lb.
Cortland, Grimes, Jonathan, Lobo, Macoun, McIntosh Opaiescent, Summer-Rambo		NAD: 40-50 p.p.m. or
	7-14	NAD: 25 p.p.m. plus Tween 20: ½ pt.
		OR
	14-16 (Fruit 3/8"-7/16" in dia.)	NAA: 5 p.p.m. plus Tween 20: ½ pt. or NAA: 10-15 p.p.m.
		OR
	14-21	Sevin 50% WP ½-1 lb.
Golden Delicious, Sungold	14-16	NAA: 8 p.p.m. plus Tween 20: ½ pt.
		OR
	14-21	Sevin 50% WP ½ lb.
Red Delicious	(Fruit 3/8"-7/16" in dia.)	NAA: 10 p.p.m. or NAA: 5 p.p.m. plus Tween 20: ½ pt.
		OR
	14-21	Sevin 50% WP ½ lb.
Stayman Winesap	14-16 (Fruit 3/8"-7/16" in dia.)	NAD: 25 p.p.m. plus Tween 20: ½ pt.
		OR
	14-21	Sevin 50% WP ½-1 lb.
Rome Beauty	14-16 (Fruit 3/8"-7/16" in dia.)	NAA: 5 p.p.m. plus Tween 20: ½ pt.
		OR
	14-21	Sevin 50% WP ½-1 lb.

Source: Tree-Fruit Production Recommendations, Rutgers University, Extension Bulletin 407, pp. 5-6.

111-7-3

THINNING OF OTHER FRUIT

PEARS

Use the NAD only at 25 p.p.m. applied at petal fall or 5 to 7 days after full bloom. This has been satisfactory for Bartlett and Bosc. Do not use later because small, misshapen fruit may result.

PEACHES

Fruitone CPA has been tried many times in Kentucky but has not thinned adequately. Pole thinning or using the "Kentucky Bumper" are recommended.

CHERRIES

Use pole thinning.

Source: Tree-Fruit Production Recommendations, Extension Bulletin 407, Rutgers University, p. 47.

Lesson 8

CONTROL OF INSECTS AND DISEASES

Objectives -- To develop the effective ability of orchardmen to control insects and diseases.

Problem and Analysis -- How should we control insects and diseases in the orchard?

-Types of insects
-Types of diseases
-Spray materials
-Selecting and ordering chemicals
-Time and amount of spray application
-Residue tolerances on fruit
-Health hazards

Content

I. Types of Insects

A. Insects are grouped according to their mouth parts.
1. Chewing insects have hard mouth parts that aid in biting off parts of the plant.
a. The worm stage of the codling moth feeds on the fruits.
b. The tent caterpillar feeds on the leaves.
c. The red-banded leaf roller causes damage mainly to apple fruit.
d. The grape flea beetle is destructive to grape leaves.
e. The plum curculio attacks stone fruits and apples.
2. Sucking insects have tubelike mouth parts, which they insert through the epidermis and tissues of the leaves, fruit, and stem, thus withdrawing and digesting the juices of the plants.
a. Aphids, small soft-bodied insects, feed in groups and are found to some extent on practically all fruit plants.
b. Mites have high reproductive rates and feed on a wide variety of fruit crops.
c. Leafhoppers feed on apple, pear, strawberry, grape, and bramble leaves.
d. Pear psylla, small, aphid-like insects, feed on pears.
e. Plant bugs, large sap-sucking pests, infest strawberries, pears, peaches, and brambles.
3. Lapping insects "lap up" liquids from the outer surfaces of the plant.

a. The cherry fruit fly sponges food from the foliage and fruit.
b. The apple maggot is a serious threat to apples.

II. Types of Diseases

A. A fruit disease may be caused by a fungus, bacterium, or virus, or it may be due to a physiological disorder.
1. Fungi, lower plant forms lacking chlorophyll or green coloring matter found in higher plants, exist as parasites in or on the tissues of living plants.
a. Peach leaf-curl damage occurs on the first spring leaves, produces a dusty white coating of spores, causes the leaves to drop, and weakens tree growth and crop production.
b. Scab lesions on apple leaves and fruit, blue molds on apples in storage, and brown rot on peaches, plums and cherries are all fungi.
2. Bacteria are microscopic organisms which damage fruit, foliage, and other parts of the tree, usually above the ground.
a. Crown gall, a serious problem on peach and almond trees, causes rapid, disorganized growth of plant cells.
b. Bacterial canker, which gains entrance through pruning wounds or natural openings, attacks the cherry, peach, plum, apricot, and almond.
c. Fire blight, characterized by a shriveling and blackening of the blossoms, tender shoots, and young fruit, attacks pears, quinces, apples, and crabapples.
3. Virus diseases are caused by ultra-microscopic organisms which can transmit their diseases from one plant to another by mechanical means.
a. Virus yellow affects apples and peaches and results in loss of fruit production.
b. Peach yellow, leaf pucker, and russet ring on apples, streak disease of brambles, and yellow disease of the strawberry are virus diseases.
4. Physiological diseases, or "environmental disorders," are caused by unbalanced nutrition, adverse weather conditions, or some other unfavorable conditions of the tree's environment.
a. Jonathan spots on apples are a result of uneven temperatures when they are in storage, or it can be observed when apples have been harvested when overmature.
b. Little-leaf is a result of inadequate amounts of zinc available to the trees.
c. Scalds, black end of pears, bitter pit and internal breakdown of apples, and pit burn of apricots are also considered to be physiological diseases.

III. Spray Materials

A. Pesticide chemicals are classified into three groups:
1. Fungicides - materials to control fungus diseases by preventing germination of the spores.
2. Insecticides - materials to control insects.
3. Miticides - materials to control mites.
4. Accessory material (adjuvants) - materials used as correctives, stickers, spreaders, activators, flocculators, and emulsifiers.

B. Materials for insect and mite control:
1. Insecticides consist of two general types:
   a. Stomach poisons control insects that obtain food by biting and chewing.
   b. Contact insecticides, which kill by suffocating, burning, or paralyzing insects, will control many lapping and chewing insects and insects that obtain food by sucking sap from the plant tissue.
2. Miticides, such as Kelthane and Morestan, are chemicals which are effective against mites.
3. Fumigants are used in fruit growing against nematodes and soil-borne insects.
4. The following is a list of kinds of insecticides, miticides, and fungicides available on the market:
   a. Carzol is a non-phosphate miticide for pre- or post-bloom application on apples and pears.
   b. Lead arsenate is used against curculio bulbs and leaf rollers and apple maggot.
   c. DN Compounds are used against aphids and mite eggs, scale, bud moth, and mineola moth as dormant applications.
   d. Dormant Oils are used against scale insects and pear psylla and European Red Mite eggs.
   e. Morestan is effective against mites, mite eggs, pear psylla, and powdery mildew.
   f. Rotenone is used against pests immediately before or during harvest.
   g. Chloropropylate is compatible with most insecticides and fungicides on apples and pears.
   h. Dieldrin is effective against plum curculio on tree fruits, spittle bug on strawberries, apple sawfly, tarnish plant bug, and tent caterpillars.
   i. Endosulfan is used against peach tree borers during early and late season.
   j. Galecron-Fundal is used against mites and psylla on apples and pears.
   k. Kelthane controls mites but is not effective against insects.
   l. Methoxychlor exercises control over plum curculio, codling moth, apple maggot, spittlebug, and cherry fruit fly.
   m. Omite controls mites on apple, peach, pear, plum, and prune.

n. Perthane controls early pear psylla.
o. Tedion is a specific miticide.
p. Thiodan controls peach-tree borers on peaches, plums and cherries.
q. Demeton, a systemic aphicide and miticide formulated as an emulsion concentrate, is used on apples, pears, and strawberries.
r. Diazinon, intermediate between parathion and malathion in toxicity to humans, is cleared for use on apples, pears, cherries, peaches, plums, strawberries, and grapes, to control many different insects.
s. Ethion used with oils on apples for mites, mite eggs, aphids, scale; it is not used on varieties ripened before McIntosh.
t. Imidan is used on curculio, codling moth, and oriental fruit moth.
u. Malathion is used against insect pests and is especially effective against many forms of aphids.
v. Parathion is used to control aphids, bud moth, pear psylla, curculio, codling moth, oriental fruit moth, and grasshoppers.
w. Phosalone, a contact or stomach poison, is used on apples, pears, and grapes for aphids, codling moths, maggots, leafrollers, curculio, psylla, and mites.
x. Phosphamidon controls aphids, mites, and leafhoppers as contact and systemic, early sprays on apples.
y. Trithion is cleared for use on most fruits.
z. Sevin controls a wide range of insects but is not effective against mites.

C. Materials for disease control
1. Copper fungicides are of two types:
a. Bordeaux is a tank-mix of copper sulfate, hydrated lime, and water.
b. Proprietary copper compounds are fungicides or bactericides containing copper in a low-soluble, slowly available form.
2. Sulfur fungicides
a. Elemental sulfur, sulfur in pure form, is reduced to extremely small particles by mechanical grinding or by other processes which make it useful for disease control.
b. Lime-sulfur kills certain fungus spores which are germinating or partly established.
3. Organic fungicides
a. Benomy is used on peach, nectarine, apricot, cherry, prune, and plum for brown rot, mildew, and scab. It also controls mildew on apples, scab on apples, and leaf spot on cherries.
b. Dikar is used for scab on apples and for mite suppression, also cedar apple rust.
c. Ferbam is suggested to control leaf spot on sour cherries, peach leaf curl and cedar apple rust. It is as effective as elemental sulfur in controlling scabs on apples.

d. Botran is used specifically for water molds, such as brown rot and leak on strawberries.
e. Captan has given good control of apple scab, cherry leaf spot, brown rot on stone fruit, and fruit rot on strawberries.
f. Cyprex has given good control of scab on red apples and leaf spot on sour cherries.
g. Dichlone or Phygon is suggested in blossom sprays to control brown-rot blossom blight on peaches, plums, and cherries.
h. Dinocap is used for powdery mildew, and it also gives some mite control.
i. Folpet is excellent for nearly all summer diseases on apples and peaches.
j. Glyodin is used as a protective fungicide on apples to control scab and on cherries to control leaf spots.
k. Guthion controls most major insects from bloom to harvest.
l. Niacide M is suggested for use on apples any time throughout the growing season.

IV. Selecting and Ordering Spray Materials

A. Spray material must be ordered several months in advance of the spring season.

B. The first consideration in ordering is to determine the spray schedule to be followed.

C. This schedule can be obtained from the local Agricultural Extension Agent or at the Extension winter fruit meeting.

D. It will suggest the number of sprays to be applied, materials to be used, and the dilutions.

E. Every grower should request that his name be placed on the regular mailing list for spray schedule.

F. When ordering, the orchardman should remember that more spray will be used for the afterbloom than for the prebloom application.

G. The grower must make sure all chemicals used are cleared and labelled for the specific fruit.

V. Time and Amounts of Spray Applications

A. Most insects and diseases tend to build up as the growing season advances; therefore, it is important that correct materials be applied thoroughly at the proper time early in the season in order to reduce the early generation of insects and diseases.

9. Cover crops in treated areas should not be fed to livestock.
10. Do not feed insecticide-contaminated apple or pear pomace to livestock.

C. Watch for these symptoms:
1. The initial symptoms of organic phosphorus poisoning are giddiness, headache, nausea, vomiting, excessive sweating, and lightness of the chest.
2. These are followed by or accompanied by blurring of vision, diarrhea, excessive salivation, watering of the eyes, twitching of muscles, and mental confusion.
3. Late signs are fluid in the chest, convulsions, coma, loss of urinary or bowel control, and respiratory failure.

D. What to do for poisoning:
1. In severe cases of organic phosphorus poisoning breathing may stop. In this case, artificial respiration is the most important first aid until breathing has resumed.
2. Get the patient to a hospital or physician as soon as possible.
3. Never try to give anything by mouth to an unconscious patient.
4. If insecticides have been swallowed, induce vomiting.
5. Where insecticide has come in contact with skin, bathe the patient.
6. If the eyes have been contaminated with spray, wash them immediately with flowing water.
7. Make the patient lie down, and keep him warm.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
1. Control of orchard insects and diseases is a must in fruit production.
2. A grower must have a good knowledge of orchard insects and diseases.
3. Correct spray material and correct timing are critical in controlling orchard insects and diseases.

B. Things to be brought out by the class members:
1. Their knowledge of and experiences with orchard insects and diseases.
2. Their knowledge of and experiences with spray materials.

II. Conclusions

A. Orchard insects can be grouped into chewing insects, sucking insects, and lapping insects.

B. Orchard diseases are caused by fungal, bacterial, viral, or physiological disorders.

C. Spray materials are classified into fungicides, insecticides, and miticides.

D. An orchardman should select and order his spray materials several months in advance of the spring season.

E. Each orchardman is responsible for producing legally marketable fruit complying with residue tolerance.

F. When using spray materials, an orchardman should always follow directions on container labels.

III. Enrichment Activities

A. Visit local orchards and observe the spraying program.

B. Have members bring in insect- and disease-damaged fruit.

C. Invite a successful orchardman to talk to the class about spray materials.

IV. Suggested Teaching Materials

A. References
1. Modern Fruit Science, pp. 507-636.
2. Approved Practices in Fruit Production, pp. 233-289.
3. Fruit Growing, pp. 123-144.
4. Tree Fruit Recommendations, Extension Bulletin 407, 1973.
5. Kentucky Tree-Fruit Spray Schedules (latest edition), UK Bulletins ID-10, ID-11.
6. Agricultural Pesticides, Adult VoAg Instructional Unit.

B. Resource personnel
1. Consult local producers
2. Consult fruit specialists
3. For specific personnel see Vo-Ag Directory of Resource People in Kentucky.

C. Audio-visuals
1. Masters
-1 Gallons of Spray Required for Fruit Trees
-2 Dilutions for Powder and Concentrates
-3 Toxicity of Chemicals
-4 Factors Which Influence the Incidence of Disease

APPROXIMATE GALLONS OF DILUTE SPRAY SOLUTION REQUIRED FOR FRUIT TREES BY AGE

Age of Trees	Average Amount Per Application for Season in Gallons			
	Apples	Peaches	Sour Cherries	Sweet Cherries
2 to 3 years.....	.5	.7	.5	.5
5 years.....	1.5	3.0	2.5	1.5
10 years.....	6.0	5.5	6.0	6.0
12 years.....	8.0	6.0	8.0	8.0
15 to 20 years.....	12 to 20	6.0	10.0	10.0
21 to 25 years.....	20 to 35		12.0	15 to 18

Source: Modern Fruit Science, p. 529.

111-8-1

DILUTIONS FOR WETTABLE POWDER AND
EMULSIFIABLE CONCENTRATES

Type of Material	Quantities of Material for Indicated Quantities of Water			
	100 Gallons	5 Gallons	3 Gallons	1 Gallon
Wettable Powder	5 pounds	15 tablespoons	10 tablespoons	3 tablespoons
	4 pounds	13 tablespoons	8 tablespoons	8 teaspoons
	3 pounds	10 tablespoons	6 tablespoons	2 tablespoons
	2 pounds	8 tablespoons	4 tablespoons	4 teaspoons
	1 pound	3 tablespoons	6 teaspoons	2 teaspoons
	1/2 pound	5 teaspoons	1 tablespoon	1 teaspoon
Emulsifiable Concentrate	5 gallons	1 quart	1¼ pints	13 tablespoons
	4 gallons	1½ pints	1 pint	10 tablespoons
	3 gallons	1¼ pints	3/4 pint	1/4 pint
	2 gallons	3/4 pint	1/2 pint	5 tablespoons
	1 gallon	1/2 pint	8 tablespoons	3 tablespoons
	1 quart	3 tablespoons	2 tablespoons	2 teaspoons
	1 pint	5 teaspoons	1 tablespoon	1 teaspoon

Source: Modern Fruit Science, p. 529.

111-8-2

TOXICITY OF CHEMICALS

Name[1]	Type[2]	Formulations[3]	LD_{50} values mg./kg.[4] Oral	Dermal
Acaralate	A	40 WP, 2 lb. EC	5,000	>10,200
benomyl, Benlate	F	50 WP	>9,590	
captan	F	50 WP, 75 WP, D	9,000	
carbaryl, Sevin	I	50 WP, 80 WP, 4 lb. F	850	4,000
carbophenothion, Trithion	I,A	25 WP, 4 lb. F	32.2	825
Carzol SP, formetanate hydrochloride	A,I	92% SP	24	10,200
copper sulfate	F	25.2%, 35% (metallic)		
CPA	GR		300	
dalapon, Dowpon	H	74 SP	7,570	
DD (mixture)	N	100%	140	2,100
demeton, Systox	I	2 lb. EC	6	14
dichlobenil, Casoron	H	50 WP, 4 G, 10 G	3,160	500
dichlone, Phygon	F	50 WP, D	1,300	M
dicloran, Botran	F	75 WP	>10,000	
dicofol, Kelthane	A	35 WP, 1.6 lb. EC, 4 lb. EC	809	1,230
Dikar	F	80 WP		
dimethoate, Cygon	I	2.67 lb. EC	215	400
dinocap, Karathane	F	22.5 WP	980	9,400
diphenamid, Dymid, Enide	H	50 WP, 80 WP, 4 lb. F	1,048	>6,320
diuron, Karmex	H	80 WP	3,400	Low
dodine, Cyprex	F	65 WP	1,000	>1,500
EDB	N	85%	146	S
endosulfan, Thiodan	I	50 WP, 2 lb. EC	18-43	74
ethion	I	25 WP, 4 lb. EC	65	245
ferbam, Fermate	F	76 WP	>17,000	>1,000
folpet, Phaltan	F	50 WP	>10,000	M
fumazone	N	70%	173	1,420
glyodin	F	30 S	3,170	M
Imidan	I	50 WP	147-284	3,160
lead arsenate	I		10-50	
malathion, Cythion	I	25 WP, 57 EC, 4 D	1,375	>4,444
maneb, Manzate, Dithane	F	80 WP	6,750	>1,000
methoxychlor, Marlate	I	50 WP, 2 lb. EC	6,000	>6,000
Morestan	A	25 WP, 2 D	1,100	>2,000
NAA	GR		1,000	
NAD	GR			
Nemagon	N	12.1 EC, 8.6 EC	173	1,420
Omite	A	30 WP, 57 EC	2,200	
paraquat	H	2 lb. SC	150	to be avoided
parathion	I	15 WP, 4 lb. EC, 8 lb. EC, 4 lb. F	13	21
phosphamidon	I	50 SP, 8 lb. SC	24	143
Plictran	A	50 WP	540	2,000
Polyram, metiram	F	80 WP	>6,400	
rotenone	I	4 WP, 5 WP, 1.0 D	132	>1,000
silvex	H	4 lb. EC	650	N
simazine, Princep	H	80 WP	>5,000	N
streptomycin	GR		9,000	>600
2, 4, 5-TA	GR		300	
Telone	N		1 p.p.m. in air	
TEPP	I	40 EC	1	2.4
terbacil, Sinbar	H	80 WP	>5,000	>5,000
tetradifon, Tedion	A	18 WP, 1 lb. EC	>14,700	>10,000
thiram	F	65 WP	780	
zineb	F	75 WP	>5,200	>1,000
Vidden D	N	100%	1 p.p.m. in air	

[1]Trade names begin with capital letters, and common names begin with small letters.
[2]A = acaricide, F = fungicide, GR = growth regulator, H = herbicide, I = insecticide, and N = nematicide.
[3]SP = soluble powder, L = liquid, WP = wettable powder, E or EC = emulsifiable concentrate, SC = soluble concentrate, D = dust, F = flowable, and G = granular. The number before the abbreviation indicates percentage or pounds of active ingredient per gallon.
[4]LD_{50} = milligrams of substance per kilogram of body weight of the test animal. > = higher than the figure listed.
Dermal – N = little or no skin irritation, M = mild skin irritation possible, S = severe skin irritation possible

Source: Tree-Fruit Production Recommendations, Rutgers University, Extension Bulletin 407. 87 111-8-3

Factors which influence the incidence of disease

Factors associated with disease infection	Management practices that can influence these factors
Weak or injured roots	Soil compaction, drainage, plant population, insect control, fertilizer placement, fertility level, pH level, cultivation practices, planting depth, and seed selection.
Mechanical tissue injury	Insect control, fertility level, cultivation practices, pesticide application methods, and harvest practices (fruits and forages).
Thin and weak cell walls	Hybrid or variety selection, nutrient level, nutrient balance, plant population, pH level, pest control, and seed treatment.
Dead tissue	Pest control, cultivation practices, pesticide rates.
Stomata	Potassium fertilization.
Improper organic compounds, translocation, and photosynthesis	Low fertility, unbalanced fertility, soil aeration (cultivation and drainage), irrigation practices, and pest control.

Source: Crops and Soils Magazine, February, 1972, p. 15.

111-8-4

Lesson 9

HARVESTING AND MARKETING TREE FRUIT

Objective -- To develop the effective ability of growers to harvest and market their tree-fruit.

Problem and Analysis -- How should we harvest and market our tree-fruit?

-Preparing for harvest
-Harvesting the fruit
-Packing the fruit
-Storage
-Marketing fruit

Content

I. Preparing for Harvest

A. It is important to develop a "knack" for estimating crop yields several weeks in advance, thus providing the grower with time to determine the amount of labor needed, picking equipment to provide, the amount and type of packages to purchase, grading and sizing equipment needed, and the amount of storage space to provide.

B. Providing needed equipment
1. On a lax or rainy day, the grower should inventory all harvesting equipment on hand which is in usable condition.
2. Mechanical harvesting is possible for apples which go to canning factories. Equipment involved includes shaking machines, catching frames, and pickup devices. None are used in Kentucky as of this writing.
3. Each picker should be assigned a picking receptacle which is designed to handle the fruit with as little bruising as possible.
4. Containers should be avoided which have sharp edges that may bruise or cut the fruit.
5. A ladder which is light, strong, and well-balanced should be assigned to each picker.
6. Rung ladders flared at the bottom and tapered at the top are used for large trees.

C. Fruit receptacles in the orchard
1. An orchard box, preferably with finger holes in the ends for lifting, is a desirable container for field use.
2. The bulk box has gained in popularity.

D. Harvest labor
   1. It is good to have a nucleus of capable and efficient workers, some of whom are hired throughout the year, to take the lead in harvesting crops.
   2. Workmen hired by the day tend to work somewhat slower and cause less injury to the trees and fruits.

E. Proper time for picking
   1. The following are methods which are used to determine the proper time to pick apples:
      a. Time elapsed from full bloom to picking maturity.
      b. Ease of separation of fruit. When an apple is ready to pick, it can be separated from the spur without breaking the stem by lifting it with or without a slight rotating movement.
      c. The change in ground or undercolor of an apple is a more reliable index of maturity than the red or overcolor.
   2. In cherries, selecting according to overall flavor and color is perhaps the most often used method of determining when to pick.
   3. The following are guides to determine the time to pick peaches:
      a. Color, a change from whitish-green to yellowish-background, is a measure of ripeness.
      b. Firmness of flesh, in the four-to seven-pound pressure test range, is another way to determine maturity.
      c. The actual degree of desired ripeness is determined by the market outlet.
   4. Picking pears in the slightly "green" but mature stage is necessary for high quality. Maturity is determined by change in color, firmness and soluble solids - all of which indicate higher sugar content.

II. Harvesting the Fruit

A. Stop-drop sprays and the development of mechanical aids and harvesters have helped to reduce "harvest tension."

B. The "shake-and-catch" harvester is doing an acceptable job for harvesting processing fruit, with only about 15% of the fruit bruised or damaged, which is actually only a little more than is found in hand harvesting.

C. Key pointers to keep in mind while harvesting are:
   1. Take every precaution to reduce careless handling of fruit by pickers to a minimum.
   2. Start with lower branches and move to the tree tops.
   3. Do not pull stems from the fruit, or cut fruits with finger nails, or twist off spurs. Have short finger nails.
   4. Place fruit carefully in picking containers; don't drop it.
   5. Set ladders so they fall in the tree if something slips.

6. Drop adequate numbers of boxes by the trees beforehand.
7. Keep the picked fruit in the shade, take it to the packing shed, and get it in storage as quickly as feasible to minimize ripening.
8. Make every effort to start picking and finish before the fruit drops excessively, is over-mature, or is damaged by cold or unexpected heavy winds.
9. Do not drop boxes of fruit on to wagons or trucks, into stocks, or into unloading sheds or storage areas.

III. Packing the Fruit

A. Private or cooperative packing houses are commonly used.
   1. Private. Under this condition, the grower can hire his workmen on a year-round basis and work may go on in all kinds of weather.
   2. In community packing houses:
      a. The grower delivers tree-run fruit.
      b. His fruit is graded, sized, and packed out.
      c. He is given a receipt.
      d. Charges for handling, storage, and packing are deducted, and returns to the grower are pro-rated through all or part of a season.

B. On-the-farm packing facilities have several advantages:
   1. Wages, taxes, and overhead are usually lower in rural areas.
   2. It is possible to put up the size, grade, and pack currently in demand.
   3. It becomes possible to use year-round farm help to advantage in winter months.
   4. Cull fruit is kept off the fresh-fruit market.
   5. Transportation costs are lowered by disposing of cull fruits at nearby markets.
   6. Retail sales are made easier, and average net returns are increased.
   7. Control is maintained over the all-important grading operation.
   8. The packing house is used for several fruit crops and for other purposes during the off season.
   9. Farm fruit storage is used to the best possible advantage.
   10. Total net returns to the grower are increased, but managerial problems are also greatly increased.

C. Other items to be considered in construction of a packing house:
   1. Cost of building and equipment
   2. Location
      a. The packing house should be close to the orchard.
      b. It should be easily accessible by trucks.
   3. Packing house design
   4. How fruit is to be sold
   5. How fruit is to be packed
   6. Volume packed per day per season
   7. Grading and handling equipment to be used

8. If there will be a connected refrigerated storage.
9. Layout and arrangement.
10. Floors. Floors should be strong enough to support the weight of trucks, fruits, and fork lift.
11. Walls and ceilings
    a. They must keep the packing area dry.
    b. They must be durable and tight enough so that the area can be heated when packing is done in cold weather.
12. Doors and windows
    a. The packing house should have at least one 12-by-12 foot overhead door at grade level.
    b. Windows increase construction costs, reduce the use of wall space, and allow heat loss.
13. Lighting
14. Heating
15. Handling equipment
16. Grading and packing equipment
17. Dumping aids
18. Feed belts
19. Eliminators
20. Brushers
21. Sorting rolls
22. Sizing units
23. Packing belts and bins
24. Return-flow belts
25. Bagging machines
26. Automatic equipment for packing trays
27. Labor requirements
28. Annual operating costs

IV. Storage

A. Storage has four chief advantages, whether owned by a commercial concern or by the grower himself.:
   1. It provides a means for holding fruit in good condition for several months.
   2. The orderly distribution of fruit tends to stabilize prices.
   3. A continuous supply of high-quality fruit is available to the consuming public every month of the year.
   4. The mere presence of a storage facility often serves as a threat which causes buyers to offer higher prices for fruit at harvest time.

B. The basic object of storage is to keep the ripening processes at a minimum by lowering temperature and modifying the atmospheric oxygen and carbon dioxide.

C. There are three key factors contributing to the longevity of fruit in storage.
   1. Temperature
      a. Ripening processes of fruit proceed slowly if the temperature is maintained at 30°F to 32°F.
      b. The average freezing temperature is about 28.5°F.

2. Humidity
   a. Unless humidity is regulated, fruit will lose moisture and shrivel.
   b. The minimum relative humidity should not be lower than 85 percent.
3. Ventilation
   a. Ventilation is necessary for air-cooled storages as a means of lowering temperatures.
   b. Oxygen may be so low in cold storage that some ventilation will be necessary for comfort of workers.
4. Fruit maturity at harvest and rapidity of getting it into storage after picking.

D. Types of storage buildings.
1. The air-cooled storage
   a. Temperature is reduced by opening air intakes and vents and admitting coolr air when the air temperature outside is colder than the storage room temperature.
   b. The vents and intakes are closed before outside temperatures rise above the storage-room temperature.
   c. This system is most suitable for short-term storage.
2. Mechanically refrigerated storage has the advantages of:
   a. Prompt cooling of products.
   b. Maintenance of optimum relative humidity.
   c. An even holding temperature with only a 1-2° fluctuation.
3. Controlled-atmosphere storage
   a. Fruit removed from this storage keeps longer than fruit held at equal time in regular storage.
   b. Relative humidity car be maintained above 90 percent with little danger of mold growth.
   c. Fruit has a more firm, fresh taste when stored under this system.

V. Marketing Fruit

A. Methods of selling
1. Grower to retail buyer or consumer
   a. The most simple selling procedure in selling fruit is where the grower deals directly with retail grocers, pie companies, and similar outlets.
   b. Fruit is packed out of storage through winter and delivered in large trucks traveling a set route once or twice a week.
2. Selling to processors
3. Cooperative selling
   a. A standardized product can be offered.
   b. The volume of produce handled is sufficiently large to attract the larger regular buyers.
   c. An association can keep in close contact with market conditions through their specialists in large buying centers.
   d. Supplies and equipment can be purchased in wholesale lots at a savings.

e. An association can conduct advertising and publicity campaigns.

4. Roadside marketing
   a. In an attractive, friendly roadside market, most customers will pay a higher price than in supermarkets.
   b. One's overhead is low, and there are no delivery charges.
   c. Saturdays, Sundays, and holidays are the best days.
   d. Markets should be located next to the in-coming lane of traffic to a city.
   e. Adequate parking is very important.
5. Using marketing agencies
   a. A cooperative association of growers with substantial volume and uniform control over quality and conditions can serve customers who would have no interest in dealing with a smaller supplier.
   b. The larger grower needs to move his crops in a standardized pack that can be sold on description and delivered on schedule.
6. Commission houses
   a. Fruits are put on display in stores or on sidewalks.
   b. Price depends on quality and supply.
7. Jobbers
   a. A jobber is a person or a firm who specializes in supplying retailers, or others who require deliveries of relatively small amounts.
   b. Those who supply restaurants, hotels, and steamships are called "purveyors."
8. Service wholesalers
   a. These people have a group of independent retailers or small chain supermarkets that depend upon him to purchase their supplies.
   b. They are a purchasing agency for the retailers.
9. Brokers
   a. A broker is a selling agent who is a contact medium between seller and buyer.
   b. It is his job to offer what the shipper has to sell to a buyer who may need it.
10. Disposal by auction
11. Pick-it-yourself

B. Loading and shipping fruit
1. Rail vs. truck
   a. Where formerly the majority of the fresh tonnage was shipped by rail, increased freight rates and good roads have shifted emphasis to trucks.
   b. Trucks are invaluable for transporting fruit to and from wholesale markets in congested areas.
   c. The principal advantages of the motor truck are speedy service, less expense, and less handling.
2. Manner of shipment
   a. Standard refrigeration. This means protective service against heat by the use of ice placed in the refrigerator car bunker.

b. Standard refrigeration with salt. This is the same as the above, except that three percent of salt is included at each icing station at an added cost.
c. Initial icing only. The railway furnishes refrigerator cars with ice tanks filled to capacity at the time of shipment, but no further ice is furnished.
d. Ventilation service. The fruit is carried in refrigerator cars without ice.
e. Box car service. Box cars are used only in case of extreme emergency when there is a refrigerator car shortage.
f. Carriers' protective service against cold. The railways will protect the shipments against frost, freezing, or artificial overheating by thermostatically controlled heaters with forced air circulation.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
1. Orchardmen should plan carefully for the harvest season.
2. Growers should consider cold storage of their fruit.
3. There are several different systems of marketing fruit.

B. Things to be brought out by the class members:
1. Their knowledge and ideas of the harvesting process.
2. Their knowledge and ideas of cold storage of fruit.
3. Their ideas of different marketing systems.

II. Conclusions

A. Harvesting season is a critical time in producing fruit; careful planning and preparation is required.

B. Careful handling of the fruit during harvest will cause more fruit to reach market.

C. It is to the orchardman's advantage to have packing houses on his farm.

D. Placing fruit in cold storage has many advantages; it should be carefully considered.

E. There are many different marketing systems. An orchardman should select the one that best fits his needs.

III. Enrichment Activities

A. Visit local orchard and observe the harvesting process.

B. Tour local fruit-packing houses.

C. Tour local cold-storage facilities.

D. Observe the different marketings systems in the community.

IV. Suggested Teaching Materials

A. References
1. Modern Fruit Science, pp. 191-324.
2. Approved Practices in Fruit Production, pp. 291-310.
3. Growing Fruit, pp. 109-122.
4. Roadside Marketing in Kentucky, Ky. Bulletin 1D-4.

B. Resource personnel
1. Consult local producers
2. Consult local marketing specialists
3. For specific personnel, see Vo-Ag Directory of Resource Personnel in Kentucky.

C. Audio-visuals
1. Masters
-1 Key Pointers in Harvesting Fruit
-2 Advantages of On-the-Farm Packing Facilities
-3 Advantages of Storing Fruit
-4 Key Factors Contributing to the Longevity of Fruit in Storage
-5 Types of Storage Buildings
-6 Methods of Selling Fruit
-7A-D Moveable Roadside Stand
-8A-E Permanent Roadside Stand

KEY POINTERS IN HARVESTING FRUIT

1. Reduce careless handling of fruit by pickers.
2. Start with lower branches and move to the tree tops.
3. Do not pull stems from the fruit, cut fruit with finger nails, or twist off spurs.
4. Place fruit carefully in picking containers; don't drop it.
5. Set ladders so they fall in the tree if they slip.
6. Drop enough boxes by the tree beforehand.
7. Keep the picked fruit in the shade, take it to the packing shed or to storage as quickly as feasible to minimize ripening.
8. Start and finish picking before the fruit drops excessively, is over-mature, or is damaged by cold winds.

SOURCE: Modern Fruit Science, pp. 208-209.

111-9-1

ADVANTAGES OF ON-THE-FARM PACKING FACILITIES

1. Wages, taxes, and overhead are usually lower in rural areas.
2. Promotes putting up the size, grade, and pack currently in demand.
3. Allows use of year-round farm help.
4. Keep cull fruit off the fresh-fruit market.
5. Lowers transportation costs.
6. Makes retail sales easier and increases net returns.
7. Controls the all-important grading operation.
8. The packing house is used for several fruit crops and for other purposes.
9. Farm fruit storages used to the best advantage.
10. Increased total net returns to the grower.

SOURCE: Modern Fruit Science, pp. 211.

111-9-2

ADVANTAGES OF STORING FRUIT

1. Provides a means of holding fruit in good condition for several months.

2. The orderly distribution of fruit tends to stabilize prices.

3. A continuous supply of high-quality fruit is available to the consuming public every month of the year.

4. Often the mere presence of a storage facility may cause buyers to offer higher prices for fruit at harvest time.

SOURCE: Modern Fruit Science, p. 238.

111-9-3

KEY FACTORS CONTRIBUTING TO THE LONGEVITY OF FRUIT IN STORAGE

1. Temperature
   a. Ripening processes of fruit proceed slowly if the temperature is maintained at 30°F to 32°F.
   b. The average freezing temperature is about 28.5°F.
2. Humidity
   a. Unless humidity is regulated, fruit will lose moisture and shrivel.
   b. The minimum relative humidity should not be lower than 85 percent.
3. Ventilation
   a. Ventilation is necessary for air-cooled storages as a means of lowering temperatures.
   b. Oxygen may be so low in cold storage that some ventilation will be necessary for the comfort of the workers.
4. Fruit maturity at harvest and rapidity of getting it to storage after picking.

SOURCE: Modern Fruit Science, pp. 241-243.

111-9-4

TYPES OF STORAGE BUILDINGS

1. Air-cooled storage
2. Mechanically refrigerated storage
3. Controlled-atmosphere storage

SOURCE: Modern Fruit Science, p. 243.

METHODS OF SELLING FRUIT

1. Grower to retail buyer or consumer
2. Selling to processors
3. Cooperative selling
4. Roadside marketing
5. Using marketing agencies
6. Commission houses
7. Jobbers
8. Service wholesalers
9. Brokers
10. Disposal by auction
11. Pick-your-own

SOURCE: Modern Fruit Science, pp. 274-280.

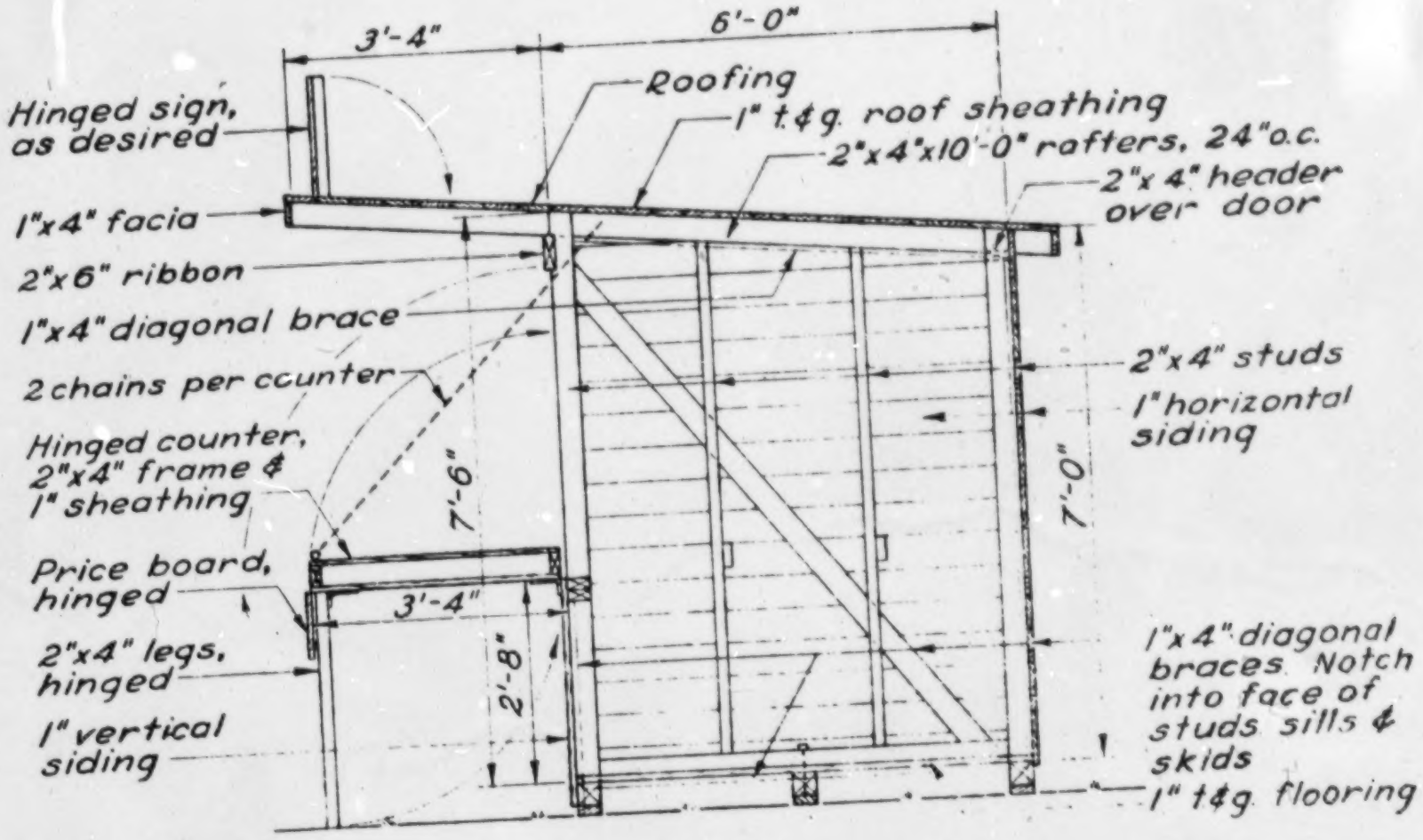
MOVEABLE ROADSIDE STAND

Source: USDA Plan 5639 available from Farm Building Plan Service, Department of Agricultural Engineering, University of Kentucky.

111-9-7A

MO CURR DCSE CNTR/RT 1957-3 A6-0

MOVEABLE ROADSIDE STAND

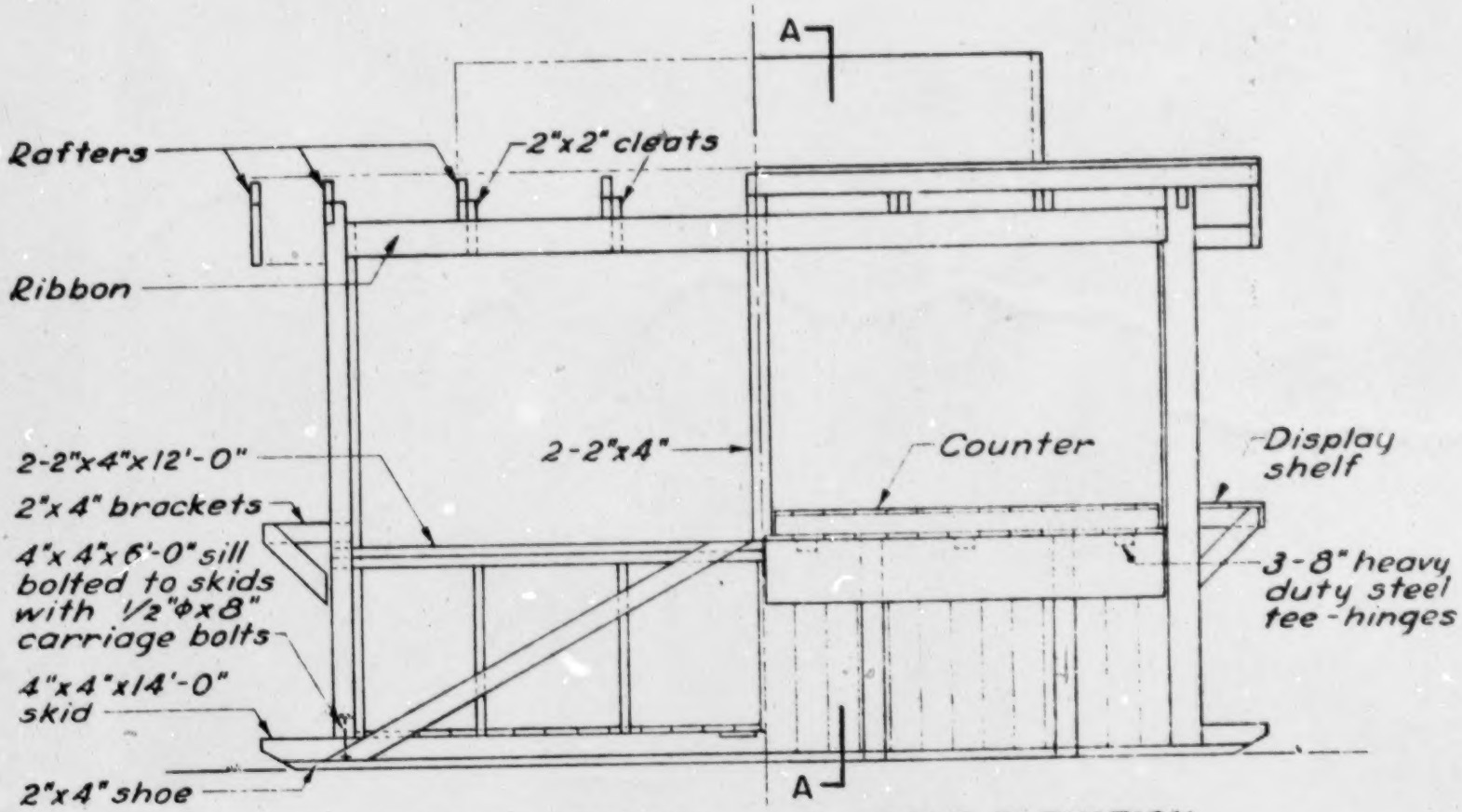


CROSS-SECTION

Source: USDA Plan 5639

111-9-7B

MOVEABLE ROADSIDE STAND



1/2 FRONT FRAMING 1/2 FRONT ELEVATION

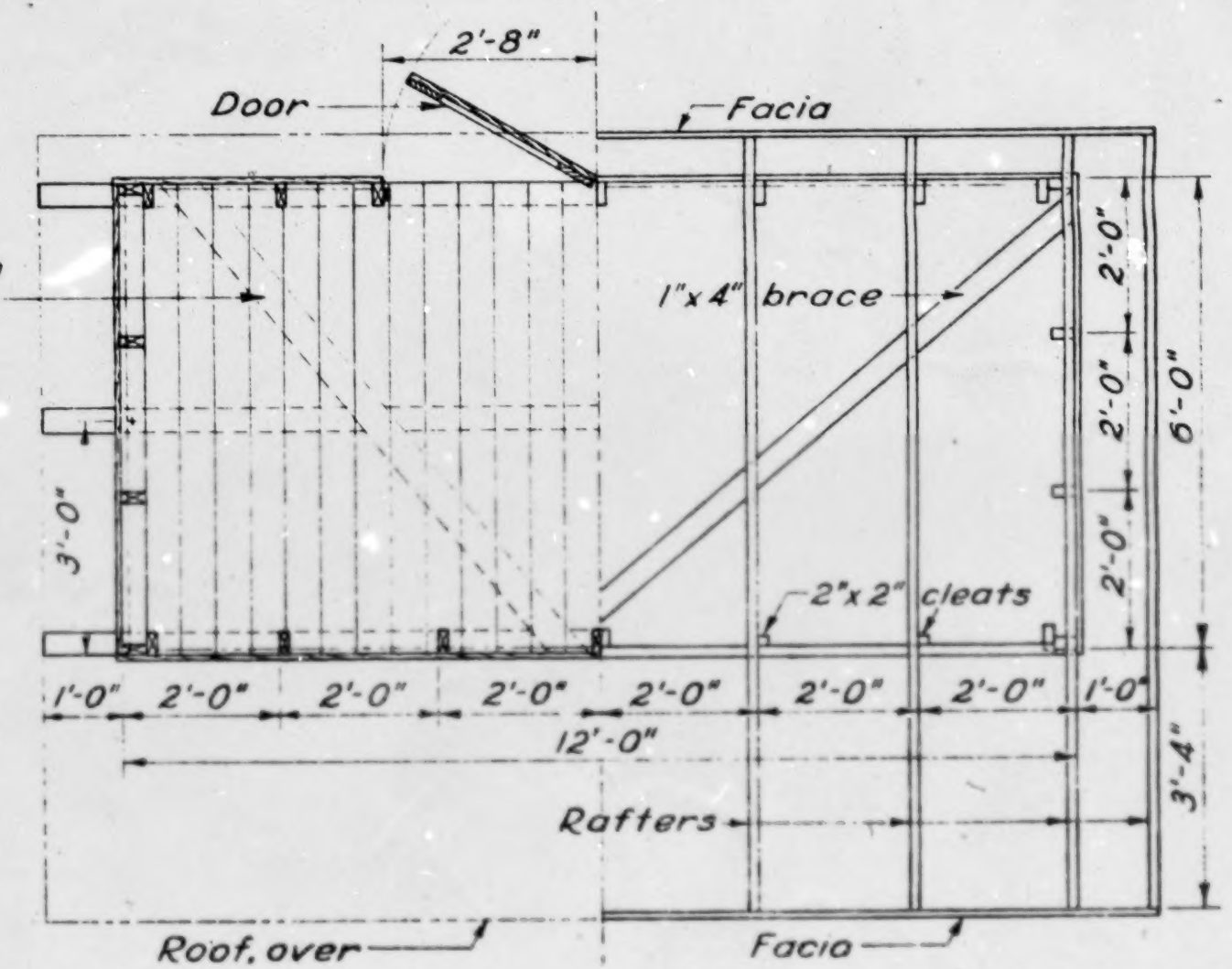
Source: USDA Plan 5639 [redacted]

[redacted] 111-9-7C

105

95

MOVEABLE ROADSIDE STAND



1/2 FLOOR PLAN 1/2 ROOF FRAMING

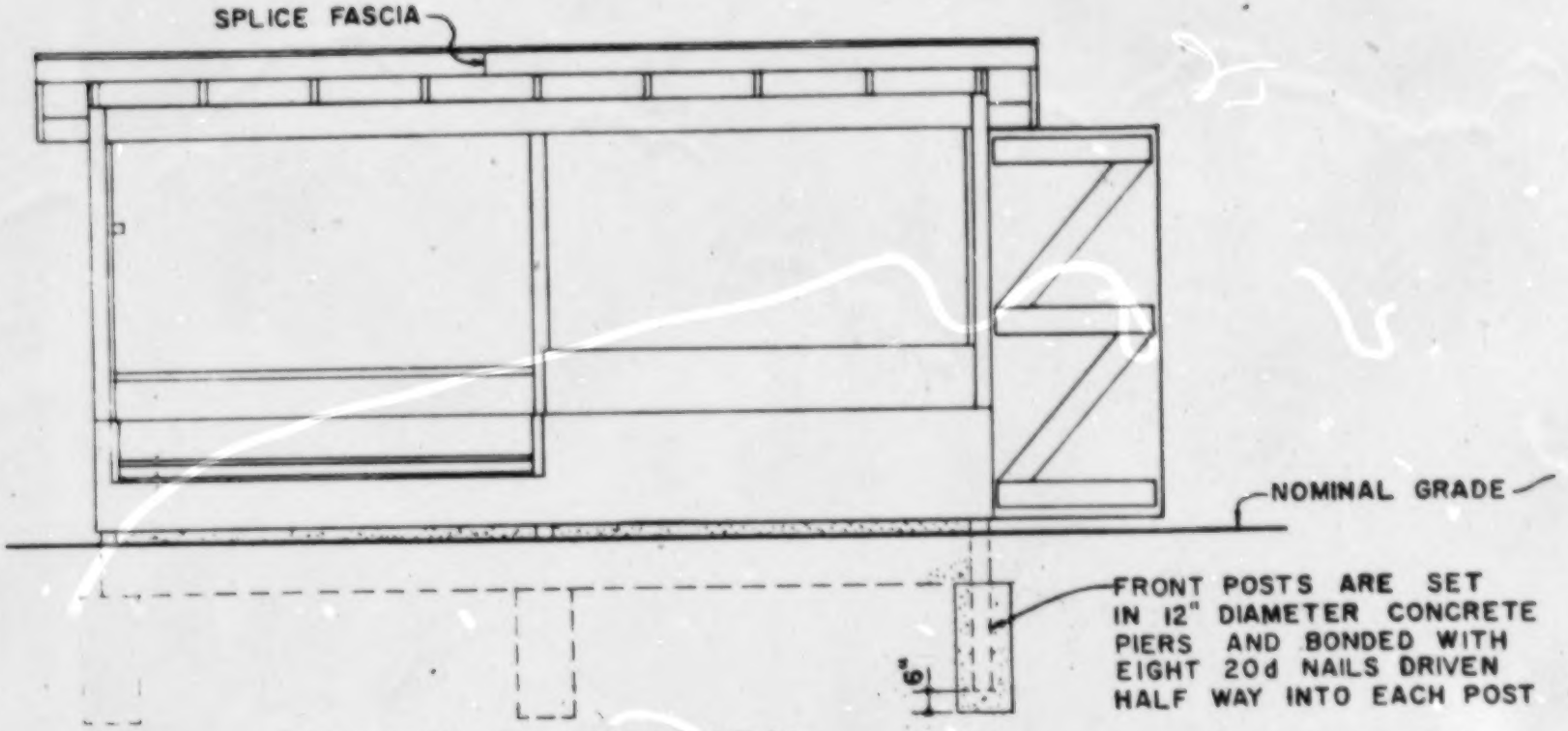
Scale: 1/2" = 1'-0"

Source: USDA Plan 5639

111-9-70

R.G. CURR DRIVE CENTER 1967-6 OK AG-0

PERMANENT ROADSIDE STAND

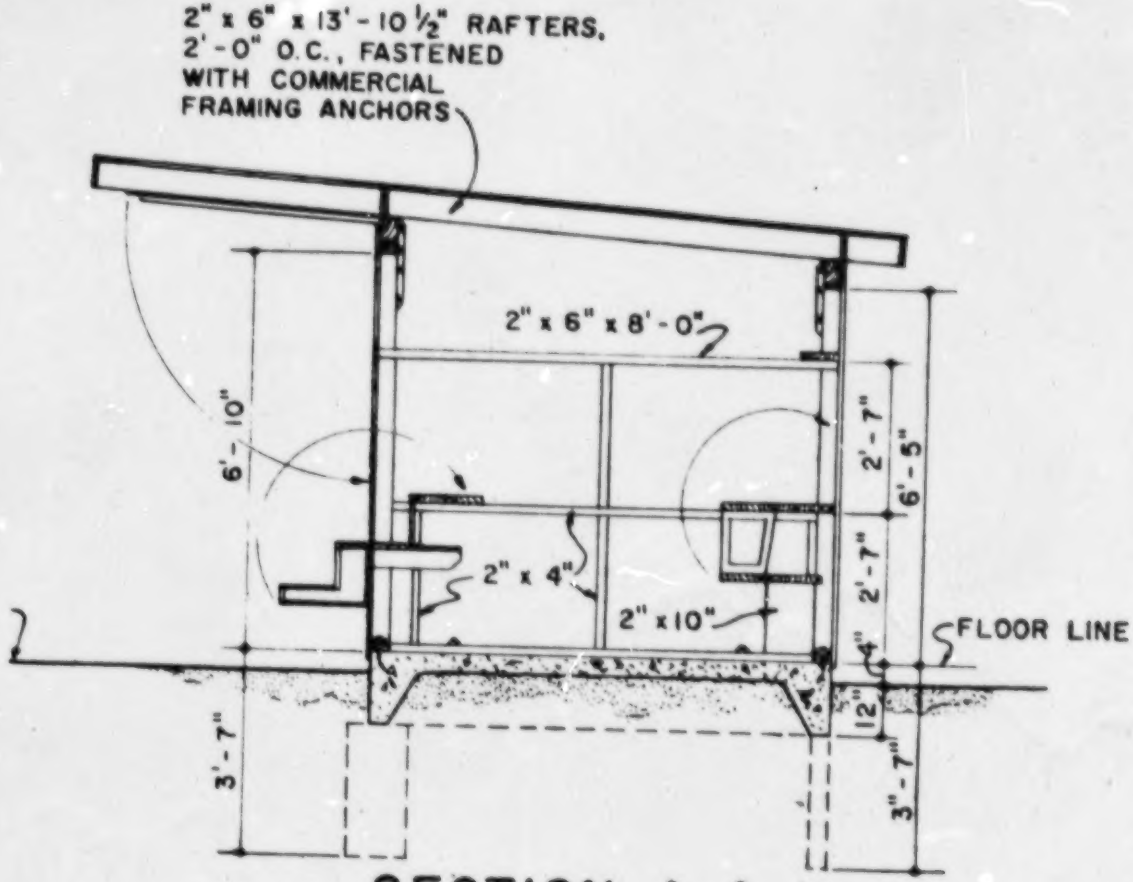

SPLICE FASCIA
NOMINAL GRADE
FRONT POSTS ARE SET IN 12" DIAMETER CONCRETE PIERS AND BONDED WITH EIGHT 20d NAILS DRIVEN HALF WAY INTO EACH POST
6"

FRONT ELEVATION

HINGED COVERS NOT SHOWN

Source: USDA Plan 5983 available from Farm Building Plan Service, Agricultural Engineering Department, University of Kentucky.

PERMANENT ROADSIDE STAND



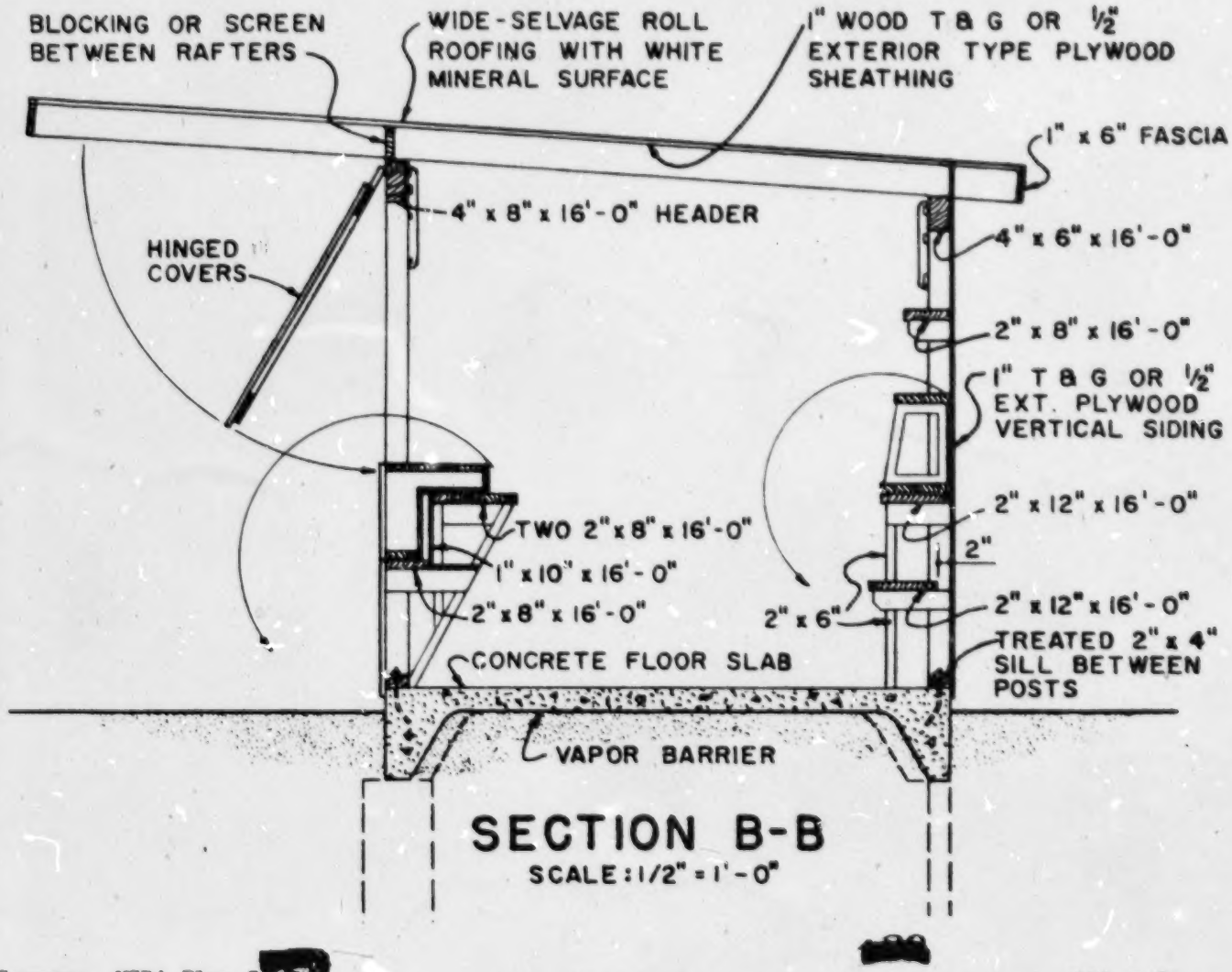
SECTION A-A
SHOWING END WALL FRAMING

Source: USDA Plan 5983

111-9-8B

U.S. GOVT. PRINT. OFFICE: 1957-O 446-0

PERMANENT ROADSIDE STAND


BLOCKING OR SCREEN BETWEEN RAFTERS
WIDE-SELVAGE ROLL ROOFING WITH WHITE MINERAL SURFACE
1" WOOD T & G OR ½" EXTERIOR TYPE PLYWOOD SHEATHING
1" x 6" FASCIA
4" x 8" x 16'-0" HEADER
4" x 6" x 16'-0"
HINGED COVERS
2" x 8" x 16'-0"
1" T & G OR ½" EXT. PLYWOOD VERTICAL SIDING
2" x 12" x 16'-0"
TWO 2" x 8" x 16'-0"
1" x 10" x 16'-0"
2" x 8" x 16'-0"
2"
2" x 6"
2" x 12" x 16'-0"
CONCRETE FLOOR SLAB
TREATED 2" x 4" SILL BETWEEN POSTS
VAPOR BARRIER

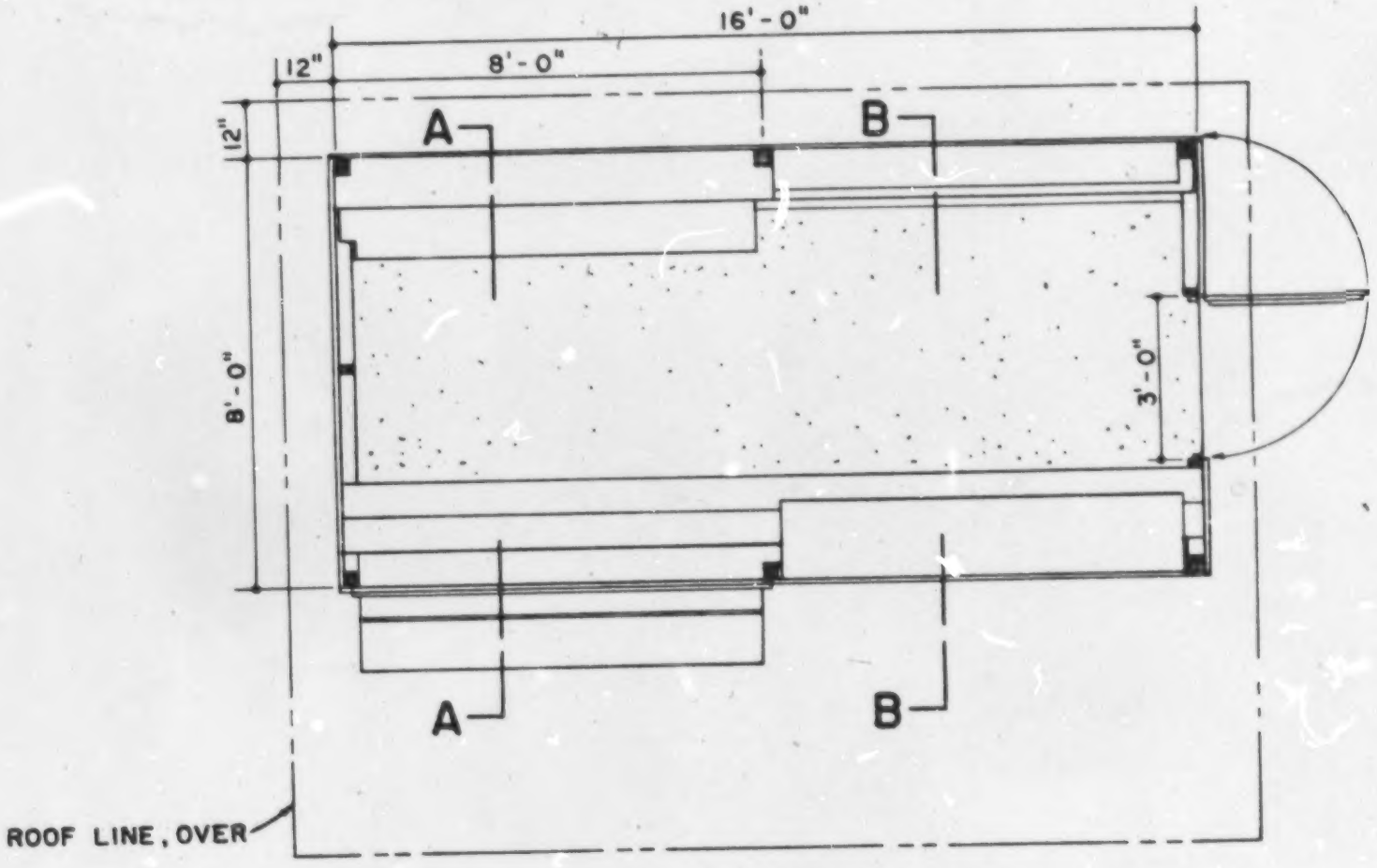
SECTION B-B

SCALE: 1/2" = 1'-0"

Source: USDA Plan 5983

111-9-8c

PERMANENT ROADSIDE STAND

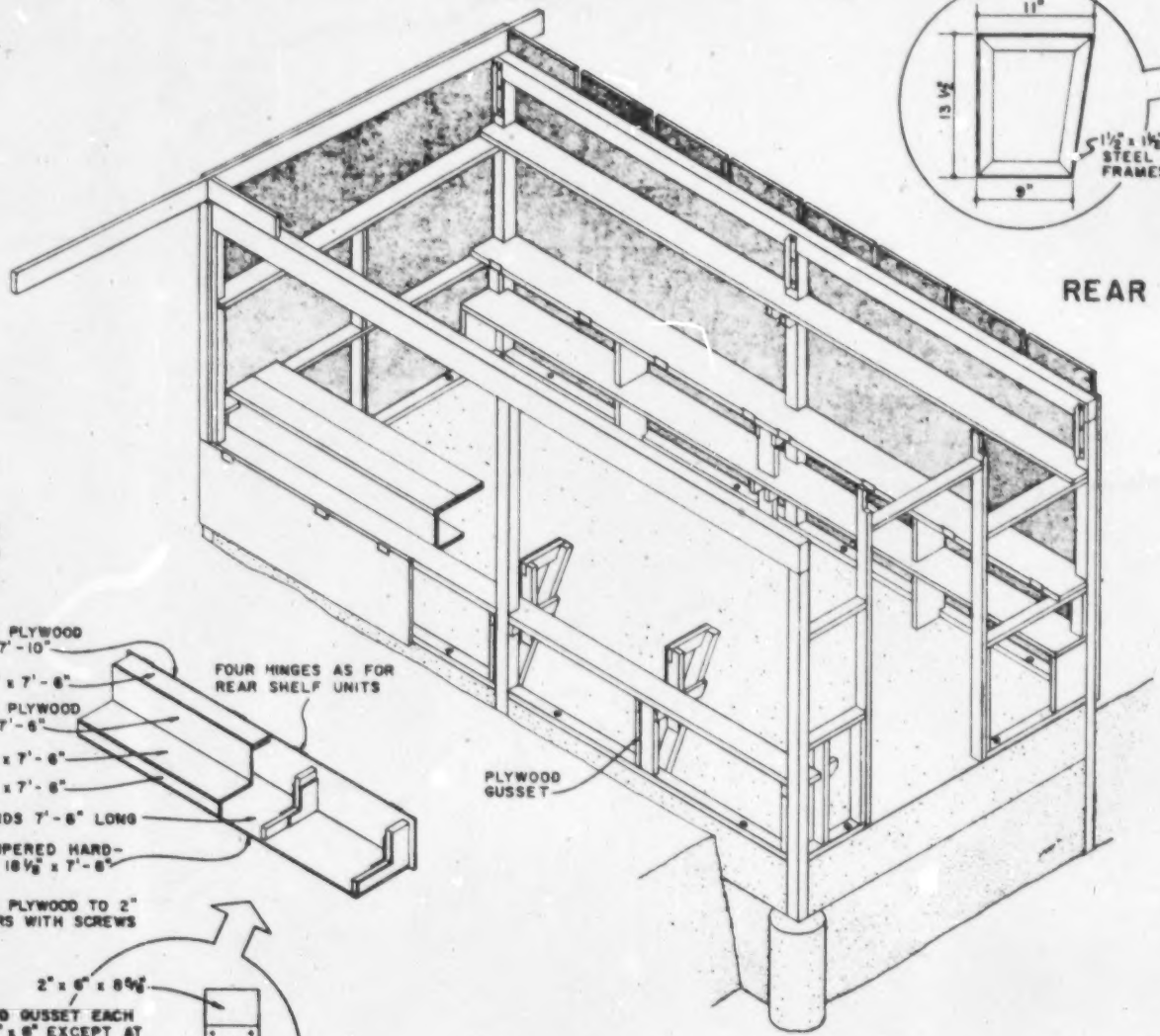


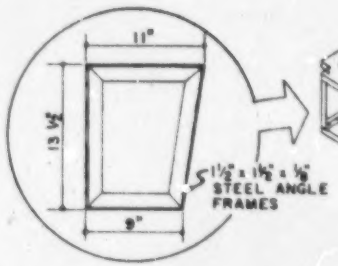
FLOOR PLAN

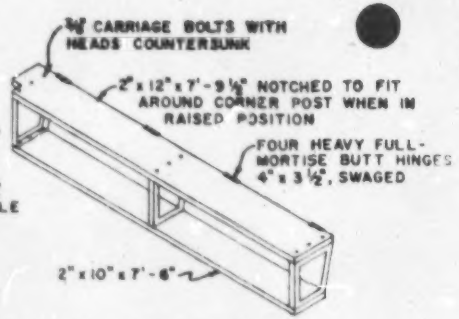
Source: USDA Plan 5983

111-9-8D

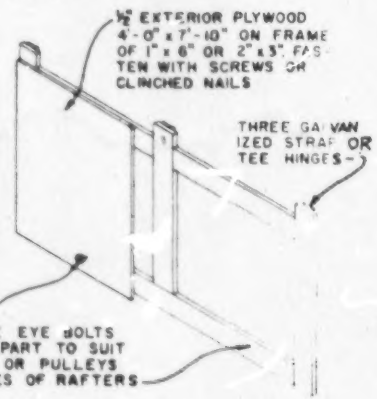
PERMANENT ROADSIDE STAND



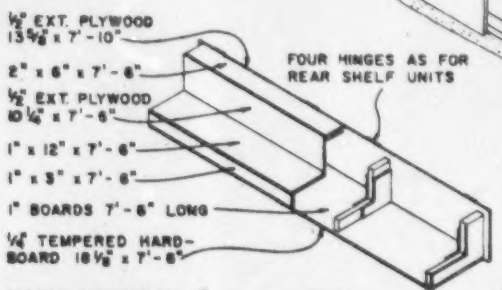


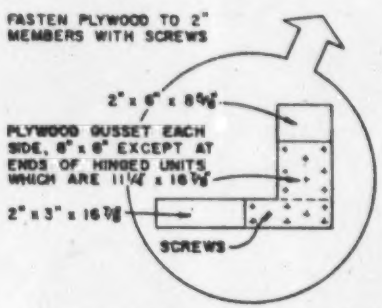

⅜" CARRIAGE BOLTS WITH HEADS COUNTERSUNK
2" x 12" x 7'-9½" NOTCHED TO FIT AROUND CORNER POST WHEN IN RAISED POSITION
FOUR HEAVY FULL-MORTISE BUTT HINGES 4" x 3½", SWAGED
2" x 10" x 7'-6"

REAR HINGED SHELF UNIT
TWO REQUIRED


½" EXTERIOR PLYWOOD 4'-0" x 7'-10" ON FRAME OF 1" x 6" OR 2" x 3", FASTEN WITH SCREWS OR CLINCHED NAILS
THREE GALVANIZED STRAP OR TEE HINGES
PROVIDE EYE BOLTS 4'-3" APART TO SUIT HOOKS OR PULLEYS ON SIDES OF RAFTERS

HINGED COVER
TWO REQUIRED


½" EXT. PLYWOOD 13⅝" x 7'-10"
2" x 6" x 7'-6"
½" EXT. PLYWOOD 10⅛" x 7'-6"
1" x 12" x 7'-6"
1" x 3" x 7'-6"
1" BOARDS 7'-6" LONG
¼" TEMPERED HARDBOARD 18⅛" x 7'-6"
FOUR HINGES AS FOR REAR SHELF UNITS


FASTEN PLYWOOD TO 2" MEMBERS WITH SCREWS
2" x 6" x 8⅝"
PLYWOOD GUSSET EACH SIDE, 8" x 8" EXCEPT AT ENDS OF HINGED UNITS, WHICH ARE 11¼" x 16⅞"
2" x 3" x 16⅞"
SCREWS

COUNTER-DISPLAY UNIT
TWO REQUIRED

VIEW SHOWING CONSTRUCTION
CUT AWAY FOR CLARITY

Source: USDA Plan 5983

Lesson 10

HOME FRUIT PRODUCTION

Objective -- To develop the effective ability of people to establish and maintain a home fruit garden.

Problem and Analysis -- How can we establish and maintain a home fruit garden?

-Selecting varieties
-Soil preparation
-Tree setting
-Pruning at time of setting
-Care after setting
-Insect and disease control on young, non-bearing trees

Content

I. Selecting Varieties

A. Dwarf or semi-dwarf trees are recommended for the home fruit orchard for the following reasons:
   1. Several trees can be maintained on a relatively small area of land. (Six dwarf trees should require an area of 24 x 24 feet. Six semi-dwarf trees would require an area of 36 x 40 feet.)
   2. Dwarf or semi-dwarf trees blend in better with the home landscape.
   3. Dwarf and semi-dwarf trees bear at an early age.
      a. Dwarf trees bear well the 3rd and 4th years.
      b. Semi-dwarf trees bear well the 4th and 5th years.
   4. Dwarf and semi-dwarf trees are easier to maintain (prune, spray, thin, pick, etc.).

B. Recommended fruit varieties for home planting (see masters at end of lesson)

II. Soil Preparation

A. Prepare the soil for setting trees by staking off tree locations and removing weeds, grass, and brush in a 4' circle for each tree location.

B. Tree holes are usually dug $1\frac{1}{2}$ x $1\frac{1}{2}$ feet deep (or slightly larger than the root system).

C. Do not place any fertilizer in the tree holes at setting time. If the soil at tree location is poor or rocky, fill the hole at planting time around and below tree with fertile top soil taken from the garden or other rich soil locations.

III. Tree Setting

A. Trees should be ordered in January or earlier and set in February or early March. For fall setting, order trees in late summer.

B. Remove or shorten crushed, split, or broken roots above the injury.

C. Spread roots out in hole, work soil in, around, and under roots to avoid air pockets.

D. When roots are well covered with soil, firm soil with the foot.

E. After filling the hole 2/3 full of soil, fill the hole with water to help settle the soil.

F. Finish filling the hole with soil.

G. With dwarf trees be sure that the graft or bud union is 2-5 inches above the soil line level. With trees (all types) on seedling rootstocks, the graft or bud union is placed just below the soil line.

IV. Pruning at Setting Time (Spring only; one-year unbranched whips and two-year-old nursery trees.)

A. Cut back the tree top to a height of 30 inches to force outside growth below this point.

B. Save one to four wide-angled side branches, spaced three to six inches apart up and down the tree trunk.

C. Do not save any two branches at the same level on the tree trunk.

D. Remove any growth closer than 18 inches to the ground.

E. Trees that may be set in the fall or mid-winter should not be pruned until spring.

V. Care After Setting

A. When new growth is well started (2 - 3 inches long) apply one-half pound of 10-10-10 fertilizer on the soil surface in a circle one foot away from the tree trunk. Fertilizer should be worked in lightly.

B. Keep weeds and grass controlled by cultivating or spraying the four-foot circle around the tree.

C. It is recommended that the four-foot circle around the tree be mulched with rotten sawdust, hay, or leaves. (Keep mulch back six inches from the tree trunk.)

VI. Insect and Disease Control on New, Young Non-Bearing Trees

A. Control scab disease by using two tablespoons of Captan per gallon of water which should be applied from the start of new growth and continued at ten day intervals through bloom period, which may be observed on nearby mature older apple trees.

B. If caterpillars (worms) or grasshoppers attack trees, spray with the insecticide Sevin.

Suggestions for Teaching the Lesson

I. Developing the Situation

A. Things to be brought out by the teacher:
1. Home fruit production can be done on a relatively small area.
2. It works well for land owners who do not have an opportunity to produce on a large scale.
3. The home orchard will blend in well with the home landscape.

B. Things to be brought out by the class members:
1. Their ideas about home fruit production.
2. Their opportunity to establish a home fruit garden.

II. Conclusions

A. Variety selection should be done carefully in order to get good producing varieties adapted to local conditions.

B. In preparing soil for setting, remove weeds, grass, and brush in a four foot circle for each tree location.

C. Trees should be ordered in January or earlier and set in February.

D. The tree holes should be large enough to accommodate the root system.

E. The tree should be watered and soil placed firmly around the root system.

F. One-year-old unbranched whips and two-year old nursery trees, when set during the spring, should be pruned.

G. A good fertilizing and weed control program is necessary after trees begin growth.

H. It will be necessary to spray the tree regularly to control insects and diseases.

III. Enrichment Activities

A. Visit local home orchards.

B. Visit class members' homes and evaluate possible home fruit gardens.

IV. Suggested Teaching Materials

A. References

1. Growing Fruits at Home, Kentucky Bulletin HO-23.
2. Dwarf Fruit Trees Selection and Care, Leaflet No. 407, U. S. Department of Agriculture.
3. Establishing and Managing Young Apple Orchards, Farmers' Bulletin No. 1897.
4. Recommendations for Establishing a Home Fruit Orchard of Dwarf or Semi-Dwarf Apple Trees.
5. Recommended Varieties for the Home Fruit Garden, Kentucky Bulletin HO-22.

B. Resource personnel

1. Local producers
2. Extension fruit specialists
3. For specific personnel, see Vo-Ag Directory of Resource People in Kentucky.

C. Audio-visuals

1. Masters
   - -1 Recommended Tree-Fruit Varieties for Home Planting
   - -2 Setting Trees
   - -3 Care After Setting
   - -4 Pruning at Setting Time

RECOMMENDED TREE-FRUIT VARIETIES FOR HOME PLANTING

(listed in order of ripening for each fruit)

APPLES (1)	
Early-Summer	Lodi (Y), Summer Champion (R), Polly Eades (Y), Paulared (R), McIntosh (R), Prima (R), Priscilla (R)
Fall	Grimes (Y), Jonathan (R), Golden Delicious (Y), Mutsu (Y), Rome (R), Melrose (R)
PEARS (1) (2)	Seckel, Maxine (4), Kieffer, Orient, Moonglow, Morgan
PEACHES	
Yellow Flesh	Harbinger (CL), Sunhaven, Harbelle, Harken, Reliance, Golden Jubilee, Cresthaven, Madison, Redskin
White Flesh	Raritan Rose, Nectar, July Heath (CL), Georgia Belle, Laterose
NECTARINES (5)	
White Flesh	Redbud, Redchief
Yellow Flesh	Pocahontas, Cherokee, Lexington, Redgold
PLUMS	Methley, Ozark Premier, French Damson, Stanley Prune, Bluefre
CHERRIES	
Sour (Pie)	Montmorency

111-10-1

SETTING TREES

A. Trees should be ordered in January, or earlier, and set in February or early March.

B. Remove or shorten any crushed, split or broken roots above the injury.

C. Spread roots out in hole, work soil in and around under roots to avoid air pockets.

D. When roots are well covered with soil, firm soil with foot.

E. After filling hole 2/3 full of soil, finish filling hole with water to help settle the soil.

F. Finish filling hole with soil.

G. Be sure that the graft or bud union is 2-5 inches above the soil line level.

Source: Recommendations for Establishing a Home Fruit Orchard of Dwarf or Semi-Dwarf Apple Trees by W. D. Armstrong and Claude Christian.

111-10-2

CARE AFTER SETTING

A. When new growth is well started (2-3 inches long) apply 1/2 pound of 10-10-10 fertilizer on soil surface (in circle 1 foot away from the tree trunk). Fertilizer should be worked in lightly.

B. Keep weeds and grass controlled by cultivating or spraying the 4-foot circle around the tree.

C. It is recommended that the 4-foot circle around the tree be mulched with rotten sawdust, hay, or leaves. (Keep mulch back six inches from the tree trunk.)

Source: Recommendations for Establishing a Home Fruit Orchard of Dwarf or Semi-Dwarf Apple Trees by W. D. Armstrong and Claude Christian.

111-10-3

PRUNING AT SETTING TIME

(spring only)
(one-year unbranched whips and 2-year-old nursery trees)

A. Cut back tree top to height of 30 inches to force outside growth below this point.

B. Save one to four wide-angled side branches, spaced three to six inches apart up and down the tree trunk.

C. Do not save any two branches at the same level on tree trunk.

D. Remove any growth closer than 18 inches of the ground.

E. Trees set in the fall or mid-winter should not be pruned until spring.

Source: Recommendations for Establishing a Home Fruit Orchard of Dwarf or Semi-Dwarf Apple Trees by W. D. Armstrong and Claude Christian.

111-10-4

APPENDIX

MY TEACHING PLAN FOR THIS COURSE

Why I am teaching this course (major learnings or outcomes expected)

_____

_____

_____

_____

_____

_____

ARRANGEMENTS FOR THE COURSE

Session No.	Date	Topic	Clock Hours

This page is for your convenience in planning and rearranging the content of this course to meet local needs and interests. Plan the course as it will be taught in the local school, showing the dates, class session number, topics, and the time in hours allocated to each topic.

TOPIC PLANNING FOR THIS COURSE

Name of Course _____

Name of Topic _____

Number of Class Meetings Allotted for this Topic _____

Teaching Objectives: (Learnings or outcomes for those enrolled)

Major Phases of the Topic: (Problems, jobs, areas, skills, key points, understandings, etc.)

Learning Activities: (Field trips, completing summary forms, panel discussions, demonstrations, etc.)

Teaching Materials Needed: (From resource material list or file)

RESOURCE MATERIALS FOR TEACHING

Unit _____ Lesson _____

Reference Books	Date Used	File Location

Other References: Bulletins, Magazines, Etc.

Audio-Visuals: Slides, Filmstrips, Motion Pictures

Magnetic, Flannel, and Bulletin Boards

Charts, Maps, Posters

Transparencies

Specimens, Models, Mounts

Human and Community Resources

Please complete and return to:
Maynard J. Iverson
7 Dickey Hall
University of Kentucky
Lexington, Kentucky 40506

ADULT INSTRUCTIONAL UNIT EVALUATION

-- A Questionnaire for Kentucky VoAg Teachers of Adults

PART I -- GENERAL INFORMATION

How many years of teaching experience do you have? _____

How many years have you taught adults in agriculture? _____

How long has it been since you have taken your last college classwork in agriculture____; in education _____: (undergraduate, graduate, or non-credit course)? _____

What is the highest degree you hold? _____

How many teachers are in your department?_____

What age level students do you teach? (✓one)
a) ____high school and adult b)_____adult only

How many other units from the University of Kentucky have you used in your teaching during the past few years?_____

PART II -- UNIT INFORMATION

NAME OF UNIT EVALUATED:_____

TYPE OF CLIENTELE TAUGHT: _____Adult Farmer ____Young Farmer
_____Other Adults (please specify)_____

Average number attending class _____

Was the interest level _____high? _____moderate? _____low?

How many lessons did you use?_____ How many class periods?_____

Indicate any lesson you added or deleted_____

_____

_____

_____

Directions: Place a check mark (✓) in the appropriate left hand column to rate the following components of the unit based on your own observations. A ranking of 5 represents an excellent rating decreasing to a rank of 1 for poor. For the open-ended questions please write on the back if additional space is needed.

Unit Design

5	4	3	2	1	
					General arrangement of parts
					Appropriateness of format for teaching adults
					Length of the unit
					Usefulness of suggestions for using the unit
					Number of lessons
					Order of lessons

Specific comments:_____

_____

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Objectives in the Unit

5 4 3 2 1

_____ Clearly stated
_____ Reasonable to reach in the allotted time
_____ Relevant to needs of the adult learner
Specific comments: _____

_____

Technical Content

5 4 3 2 1

_____ Usefulness of introductory material
_____ Sufficiently detailed for direct use in class
_____ Related to objectives
_____ Divided into appropriate problem areas
_____ Up-to-date
_____ Accuracy
_____ Reasonably complete
Specific comments: _____

_____

Suggestions for Teaching the Lessons

5 4 3 2 1

_____ Appropriate information for the teacher to bring out
_____ Appropriate items to be secured from class members
_____ Suitable conclusions
_____ Suitability of enrichment activities
Specific comments: _____

_____

Resources and Teaching Aids in the Unit

5 4 3 2 1

_____ Up-to-date
_____ Accessibility to the teacher
_____ Relevance to the unit
_____ Adaptability to the teaching plan
Specific comments: _____

_____

With what parts of the unit do you feel you need <u>additional</u> help?

____ None of them
____ Objectives
____ Content
____ Course organization and planning
____ References
____ Resources and teaching materials
____ Teaching methods
____ Other (Specify) _____

PART III -- GENERAL REACTION

Please indicate any other strengths and weaknesses that you have observed in the unit and any suggestions for improvement, revision, and/or implementation (use the back of this sheet if needed).